



INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI,

१९५४

21

I. A. R. I. 6.

MGIPC—SI—6 AR/54—7-7-54—10,000.

THE QUARTERLY REVIEW *of* BIOLOGY

25467



IARI

VOLUME 23
1948

Published by
THE WILLIAMS & WILKINS COMPANY
BALTIMORE
U. S. A.

THE QUARTERLY REVIEW OF BIOLOGY

FOUNDED BY RAYMOND PEARL



B. H. WILLIER, *Editor*
The Johns Hopkins University

H. BENTLEY GLASS
Assistant Editor

ADVISORY BOARD

ANATOMY.....	LEWIS H. WEED.....	<i>The Johns Hopkins University</i>
ANTHROPOLOGY.....	A. L. KROEBER.....	<i>University of California</i>
BEHAVIOR AND COMPAR-		
ATIVE PSYCHOLOGY....	K. S. LASHLEY.....	<i>Harvard University</i>
BOTANY.....	IRVING W. BAILEY.....	<i>Harvard University</i>
CYTOLOGY.....	CHARLES W. METZ.....	<i>University of Pennsylvania</i>
ECOLOGY.....	THOMAS PARK.....	<i>University of Chicago</i>
EMBRYOLOGY.....	E. G. CONKLIN.....	<i>Princeton University</i>
EXPERIMENTAL		
MORPHOLOGY.....	ROSS G. HARRISON.....	<i>Yale University</i>
GENERAL PHYSIOLOGY	{ G. H. PARKER.....	<i>Harvard University</i>
	{ F. O. SCHMITT.....	<i>Massachusetts Institute of Technology</i>
GENETICS.....	G. W. BEADLE.....	<i>California Institute of Technology</i>
GEOGRAPHICAL DISTRI-		
BUTION AND TAXON-		
OMY.....	ALEXANDER G. RUTHEVEN.....	<i>University of Michigan</i>
PALEONTOLOGY.....	ALFRED S. ROMER.....	<i>Harvard University</i>
ZOOLOGY.....	LIBBY H. HYMAN.....	<i>American Museum of Natural History</i>

CONTENTS

No. 1, MARCH, 1948

The Geographical Distribution of Cold-blooded Vertebrates.....	<i>P. J. Darlington, Jr.</i>	1
Schooling Behavior in Fishes.....	<i>James E. Morrow, Jr.</i>	27
New Biological Books:		
Sexual Behavior in the Human Male, White, U.S.A.....	<i>Bentley Glass</i>	39
Reviews and Brief Notices.....		42

No. 2, JUNE, 1948

The Geographical Distribution of Cold-blooded Vertebrates (Concluded)	<i>P. J. Darlington, Jr.</i>	105
Germplasm, Weismann, and Hydrozoa.....	<i>N. J. Berrill and C. K. Liu</i>	124
New Biological Books:		
Reviews and Brief Notices.....		133

No. 3, SEPTEMBER, 1948

The Mechanism of Enzymatic Oxidations and Reductions	<i>James E. LuValle and David R. Goddard</i>	197
New Biological Books:		
Reviews and Brief Notices.....		229

No. 4, DECEMBER, 1948

The Giant Axons of Annelids.....	<i>J. A. Colin Nicol</i>	291
The Principle of Stability as a Cause of Evolution.....	<i>S. J. Holmes</i>	324
New Biological Books:		
Dialectical Materialism and Scientific Research.....	<i>Bentley Glass</i>	333
Reviews and Brief Notices.....		335
Index.....		411

ROLLINS ADAMS EMERSON
AUGUST 14, 1894-DECEMBER 8, 1947
MEMBER OF THE ADVISORY BOARD OF THE
QUARTERLY REVIEW OF BIOLOGY
FROM ITS FOUNDING IN 1925

THE QUARTERLY REVIEW of BIOLOGY



THE GEOGRAPHICAL DISTRIBUTION OF COLD-BLOODED VERTEBRATES

By P. J. DARLINGTON JR.

Museum of Comparative Zoölogy, Cambridge, Mass.

WALLACE, Matthew, and most other persons who have done fundamental work on animal distribution have dealt primarily with warm-blooded animals, i.e., with mammals and birds. This was inevitable. Mammals and birds are the best known animals, and mammals have left an incomparable fossil record. But most of the million or so known kinds of animals are cold-blooded. If there is such a thing as a general pattern of animal distribution, it should be set by the myriads of cold-blooded forms, and mammals and birds should be special, and presumably divergent, cases.

I am an entomologist, but what I know about insects has convinced me that they, and most other invertebrates, are not yet good material for the study of zoögeography. They are in every way too little known, and their powers of dispersal are too great or too doubtful. The cold-blooded vertebrates are better known; they have left a better fossil record, although not so good a one as could be wished; and their powers of dispersal are limited and better understood. It seems to me that the cold-blooded vertebrates are therefore the best animals with which to begin study of the general pattern of animal distribution. Other animals, including insects, may add to our understanding in special cases, but their distributions are likely to be

most significant when compared with the cold-blooded-vertebrate pattern.

The present paper is a survey of the geographical distribution of all existing cold-blooded vertebrates except marine fishes; that is, of fresh-water fishes, amphibians, and reptiles. It attempts to answer four questions. What is the main pattern of distribution? How has it evolved? Why has it evolved? And what does it tell us about ancient lands and climates? To find the main pattern, and to fit into it in their proper places the curious details that are so often selected and overstressed by zoögeographers, has been a matter of hard work, and has taken several years. To trace the evolution of the pattern has required additional work, and consideration of processes and clues.

SPREADING AND RECEDING OF ANIMALS

That animals are constantly evolving in some places, spreading to others, and receding from others, and thus forming new geographical patterns, is a commonplace, yet one that is not well understood. During the evolution of animals upon the earth, many faunas have succeeded each other. The succession of faunas has involved on the one hand evolution, radiation, and spreading of new dominant groups of animals, and on the other recession and extinction of most species of previously dominant groups. These two processes

are related. There is obviously a limit to the amount of life the earth can support. When an old fauna disappears and is replaced by a new one, there is probably no great change in the sum of existing life. It is therefore statistically probable that for every new species that arises an old one becomes extinct, and that for every dominant group of animals that spreads an old one disappears or is reduced to a few relicts. This proposition cannot be proved, but it can be illustrated. According to Simpson (1940a, p. 158), just before South and North America were united toward the end of the Pliocene they had about 29 and 27 families of land mammals, respectively. With two doubtful exceptions, they did not then have any families in common. After their union, the two continents exchanged mammals very extensively. In the Pleistocene they had 22 families in common, and further movements and many extinctions have occurred. After all the shuffling, South America has again 29 families of land mammals; North America, only 23. Each continent has gained certain families and lost others, but the total number of families on each is about what it was before. It seems to me no more possible to have new groups of animals constantly spreading over the world without an *approximately equal* amount of recession of old groups, than to have new generations of animals constantly being born without the death of old generations. It think, therefore, that the recession of animals is probably just about as common and important a phenomenon as spreading. It might be argued that evolution and spreading are gradual processes, which continue for long periods, and that recession and extinction are rapid and soon completed, so that at any given time most groups of animals are spreading and but few receding; yet this may not be true. If the recession of some animals is due to the spread of others, the two processes might be equally slow. I shall assume here that any group of animals at any time is as likely to be receding as spreading, and that only a study of each case can decide which process is really occurring.

The rates of spreading and receding must partly determine the age of animal distributions, which should not be confused with the geological age of the animals themselves. The fact that a group of animals is fossil in, say, the Triassic does not mean that the present distribution of the group must reflect Mesozoic geography. In the case of insects, for example, many fly well and disperse rapidly, and

the pattern of their distribution may be due less to their antiquity than to the rapidity with which they spread and recede. A comparison of insects in Baltic amber with those living today shows that, between the Oligocene and the present, many groups have withdrawn from Europe to the farthest corners of the earth (Ander, 1942). A comparison of European fossil fresh-water fishes with existing fishes, over the longer time from the Eocene to the present, shows much less movement. Most fresh-water fish families perhaps date from the late Cretaceous, while many insect families are older, but the fishes probably have the older distributions. I doubt whether any existing animals have a pattern of distribution older than that of fresh-water fishes.

CLUES TO THE HISTORIES OF DISTRIBUTIONS

Before discussing the clues that are supposed to show the places of origin and directions of dispersal of groups of animals, especially of taxonomic families, the distribution of one particular family may well be given for reference. The fresh-water fish family Catostomidae, comprising the suckers and buffalo fishes, is now chiefly North American: 18 genera and 84 species are listed from North America south to Guatemala (Jordan *et al.*, 1930). Only two species of the family are known anywhere in the world outside this area. One belongs to the genus *Catostomus*. There are 20 species of this genus in America. A single one of them, ranging across northern North America from Maine to arctic Alaska, occurs also in eastern Siberia west to the Tana River. The Siberian population is only subspecifically differentiated. The other non-American species, with 3 subspecies, occurs in China. It is well differentiated, forming a genus of its own, *Myxocyprinus*. Fossil suckers are recorded from the Eocene not only in North America but also in northern China. The closest relatives of the catostomids are the cyprinids, or carps. The two families are related and distributed in such a way as to suggest that catostomids were once numerous in eastern Asia, and that cyprinids have been derived from them and have replaced them there (cf. Nichols, 1943, p. 58).

Some zoogeographers take as the place of origin of a family the place where genera and species are most numerous, and assume that outlying forms have spread away from that place. This assumption implies another, namely, that most animal groups are increasing and spreading most of the

time, and that recession and disappearance are unusual. This, as I have tried to show, is not a safe assumption. If spreading and receding are equally common, persons who take numbers of genera and species as the principal clues to places of origin and directions of spread of families are going to reach wrong conclusions about half the time. They would probably decide wrongly in the case of the Catostomidae. Of course if other evidence indicates that a given group is expanding—if, for example, the group is dominant wherever it occurs, and if it has left numerous fossils, all within the present range of the group—then the numbers of forms in different places become more significant.

Another clue to the history of families is degree of differentiation. There should be greater differences between genera and between species, and more endemism, where a family has been long established than where it has just arrived. This clue is useful, and can exactly reverse the significance of mere counting. In the Catostomidae again, the *Catostomus* in eastern Siberia is only slightly differentiated, and this, together with the fact that there are 20 species of the genus in America and but the one in Siberia, suggests movement from America to Siberia. But the single catostomid in China is generically differentiated, and in spite of counts of genera and species it is probably a relict dating from a time when catostomids were numerous in eastern Asia.

A third clue is extent of area. Some (e. g., Willis, 1922) have supposed that the area occupied by a group of organisms increases directly with the age of the group. If this were so, the place of origin of a family would be the center of its range. If it be granted that recession is as common as spreading of animals, this clue is worthless by itself, but it has some value in connection with other clues. The fact that the single *Catostomus* in Siberia occupies there a comparatively small area increases the likelihood that it has recently come from America.

A fourth, better clue is continuity of area. The Siberian *Catostomus* occupies an area which is not only smaller than but is as nearly as possible continuous with the area occupied in America, and this is consistent with its being a recent immigrant into Siberia. The Chinese *Myxocyprinus* also occupies a rather small area, but one which is isolated from America not only by Bering Strait but further by about 3,000 miles of habitable continent, and this is consistent with its being a relict of a receding

group. It illustrates what may be a general principle that is not always recognized: that well differentiated forms isolated from the main range of a family *in or across areas inhabited by other, competing families* (in this case the Cyprinidae) are likely to be not immigrants but relicts persisting where the first family was once numerous. This suggests a further general principle: that if families of animals arise in certain places because of favorable conditions therein, they are likely to begin recession in the same places because of the rise of later families reacting to the same conditions. In other words, centers of evolution and dispersal are likely to be also centers of extinction. This is a corollary of the proposition that spreading and receding are related and equal processes in the animal world.

A fifth, very useful clue to family histories is the distribution of related, competing, or associated families. The distribution of the *Catostomidae* is best understood along with that of the related and competing Cyprinidae, for example.

At this point it will be well to sound a warning. Taken together, these clues are significant, but not infallible. I want to emphasize this with an example. *Esox*, the only genus of the family Esocidae, is a genus of fresh-water fishes comprising the true pikes, pickerels, and muskalonge. It has four species endemic in eastern North America, one endemic in the Amur River in northeastern Asia, and one (*E. lucius* L., the pike) occurring across North America from Labrador and New York to Alaska, and across northern Asia and Europe to the British Isles. On the basis of these facts alone, almost any zoogeographer would say that *Esox* originated in eastern North America (5 species, 4 endemic), then reached eastern Asia (2 species, 1 endemic), and finally and recently reached Europe (1 species, not endemic). The distribution of the pike is almost continuous, as if it had spread recently. Moreover, the present distribution of related families, especially of the Umbridae, is consistent with a North American origin of the whole order Haplomi to which the family Esocidae belongs. Nevertheless, there are several well preserved fossil species of *Esox* in the Oligocene and Miocene of Europe; and *Palaeoesox*, the earliest known member of the Haplomi, is in the Eocene of Europe (Berg, 1936); while neither *Esox* nor any related fish is known fossil in America. So, in spite of all contrary clues, the pike in Europe is perhaps more likely a survivor of a receding group than an immigrant from America. The reason for its

survival may be that it has unusual tolerance for cold; it is one of the few true fresh-water fishes that are widely distributed in the Arctic. This probably enabled it to cross a late Siberian-Alaskan land bridge, but it perhaps crossed from Asia to America rather than the reverse, and all American *Esox* apparently came from Eurasian stock in the first place.

The history of the Catostomidae probably involves at least two crossings of Bering land bridges, an early one from the Old World to America, and a late one back to the near part of Siberia. The history of the Esocidae also probably involves two crossings, one early and one late, but both perhaps from Eurasia to America. The present distributions of other animals that disperse more rapidly than fresh-water fishes may be products of still more complex movements. That is another reason for not trusting single clues in working out the histories of families.

Of course, there are other, special clues that help to reveal histories in special cases. For example, when a family's range includes a recently glaciated area, a movement into that area is obvious. One clue I do *not* trust is the distribution of primitive forms, which are supposed by some persons to mark the place of origin of a family, and by others, the periphery of its range. Probably they may mark either, or both.

The best clues, of course, are fossils, but the fossil record is not easy to read. Not only is the record fragmentary; it is full of misidentifications and misinterpretations which are especially troublesome in certain existing cold-blooded vertebrate groups. Even when a fossil is correctly identified, its significance may be misunderstood. Matthew, for example, knew that the fresh-water fish family Osteoglossidae, now tropical, was fossil in North America in the Eocene, and he deduced a northern origin for it, but fossil osteoglossids have recently been found in Sumatra too, probably also in the Eocene, and they cancel out the North American fossils, so far as place of origin of the family goes. I have dealt very cautiously with fossils, and have usually accepted only those that have been critically studied by specialists. Except where otherwise stated, my summaries of fossil histories follow Romer (1945).

I have tried to make it clear that, except where the fossil record is very full, the task of tracing the history of the distribution of animal groups involves clues and probabilities more than facts. A

reasonable method of procedure is to work out the probabilities independently in each of a series of cases, then to put the cases together and look for a common pattern. If one is found, it will go far to confirm the probabilities in the separate cases. This is what I shall try to do for the several existing groups of cold-blooded vertebrates.

FRESH-WATER FISHES

I am greatly indebted to Dr. George S. Myers for guidance in my work on fishes, although he is not responsible for my conclusions. To understand what I shall say about fresh-water fishes, the reader should be familiar with two papers, one by Myers (1938) and one by Regan (1922).

Certain families of fishes possess an ancient physiological inability to survive in salt sea water, which binds them to the land as securely as any known animals. These strictly fresh-water groups form Myers' *primary division* of fresh-water fishes (1938). Some other families that live chiefly in fresh water sometimes enter the sea and can survive there for a limited time. These somewhat salt-tolerant groups form Myers' *secondary division* of fresh-water fishes. Many other fishes that occur in fresh water are semi-marine, or migratory, or derived from marine or migratory families. They or their recent ancestors have probably been able to pass freely through the sea. They form a *peripheral division* of fresh-water fishes (cf. Nichols, 1928). For the composition of these three divisions, see Table 1.

There is no absolute northern limit to the distribution of fresh-water fishes except the northern limit of the continents. Species of Cyprinidae and Percidae are widely distributed in arctic Eurasia, and one American cyprinid and one percoid (the pikeperch) probably enter the Arctic in western Canada, although neither family is yet known in Alaska. The trout-perch (Percopsidae), too, probably enters the Arctic in western Canada. The pike and one sucker occur above the Arctic Circle in western Canada, Alaska, and parts of northern Eurasia. And the blackfish *Dallia*, forming a monotypic family, is confined to subarctic and arctic Alaska and eastern Siberia. (Data from Evermann & Goldsborough, 1907; Berg, various papers; Cameron *et al.*, 1947; and E. B. S. Logier, letter.) Primary-division fishes like those mentioned are few in the far north, but peripheral fresh-water species swarm there. Southwards, primary-division fishes reach the tip of South Africa. They

TABLE 1

Existing fresh-water fishes of the world

This list includes all groups of the primary (1st) and secondary (2nd) divisions of fresh-water fishes, but only a few of the more important families of peripheral (per) fishes, and no marine ones; if all marine groups of which one or more members live in or enter fresh water were included, this table would be increased by something like 100 families! The classification follows Regan (1929), with a few changes and additions. Numbers of genera and species are, in the larger families, only approximations. Groups belonging to the great fresh-water order Ostariophysi are in bold-face. See text for further explanation.

-
- Class AGNATHA, cyclostomes
- (per) Petromyzonidae, lampreys: cool N. & S. hemispheres; ca. 8 genera, more than 20 species; anadromous and resident in fresh water
- Class CHONDRICHTHYES, sharks, rays, etc.
- (per) Potamotrygonidae, river rays: South America; ca. 3 genera, 14 species; related to marine sting rays
- Class OSTEICHTHYES, bony fishes
- (NON-TELEOSTEI, archaic bony fishes)
- Order *Chondrostei*
- (per) Acipenseridae, sturgeons: cool N. hemisphere; ca. 5 genera, 20 species; anadromous and resident in fresh water
- (1st) Polyodontidae, paddle-fishes: one monotypic genus in China, another in eastern North America
- Order *Cladistia*
- (1st) Polypteridae, bichirs: Africa; 2 genera, ca. 13 species
- Order *Protospondyli*
- (1st) Amiidae, bowfins: E. North America; one existing species
- Order *Ginglymodi*
- (2nd) Lepisosteidae, garpikes: E. North America, Central America, Cuba; one genus, 4 or 5 species
- Order *Dipnoi*
- (1st) Ceratodontidae, lungfishes: Australia; one existing species
- (1st) Lepidosirenidae, lungfishes: one genus, 3 species in Africa; another genus, one species in South America (TELEOSTEI, higher bony fishes)
- Order *Isospondyli*
- (per) Salmonidae, Coregonidae, Phyllogephyridae (Thymallidae); salmon, trout, etc.: cool N. hemisphere; many genera and species; anadromous and resident in fresh water
- (per) Galaxiidae, Aplochitonidae, Retropinnatidae; "southern trout" etc.: cool S. hemisphere; ca. 7 genera, 50 species; catadromous and resident in fresh water
- (1st) Phractolaemidae, Pantodontidae, Gymnarchidae, Kneriidae, Mormyridae: Africa; first 3 families, monotypic; Kneriidae, ca. 3 genera, 6 species; Mormyridae, ca. 10 genera, 150 species
- (1st) Notopteridae: Africa, Orient; ca. 2 genera, 5 species
- (1st) Osteoglossidae: one monotypic genus in Africa; another genus, 2 species in the Orient and Australia; 2 monotypic genera in South America
- (1st) Hiodontidae, moon-eyes: E. North America; ca. 2 genera, 3 species
- Order *Haplomi*
- (1st) Umbridae, Dallidae, Esocidae; mud-minnows, blackfish, pikes: cool N. hemisphere; 4 genera, ca. 10 species
- Order Ostariophysi
- (1st) Siluroidea (part), 22 fresh-water families, catfishes: the continental regions excepting the Australian; more than 200 genera, ca. 1800 species
- (per) *Siluroidea* (part), 2 *marine* families, catfishes: warm seas and remote fresh waters including Australia; numerous genera, ca. 150 species
- (1st) Characiformes, 6 families, characins: Africa, South & Central America; more than 100 genera, ca. 950 species
- (1st) Gymnotiformes, 4 families, gymnotid eels: South & Central America; ca. 17 genera, 35 species
- (1st) Cypriniformes, 4 families, as follows: **Catostomidae**, suckers etc.: 2 genera, 2 species in E. Asia; ca. 18 genera, 84 species in North America; **Homalopteridae**: Orient, ca. 17 genera, 50 species; **Cobitidae**: numerous in Orient, fewer in temperate Eurasia, northern Africa; many genera and species; **Cyprinidae**, carps etc.: diverse and numerous in tropical and temperate Eurasia, fewer in Africa and North America; many genera, ca. 1,700 species

TABLE 1—continued

Order *Apodes*

- (per) Anguillidae, true eels: discontinuous tropical and temperate areas; one genus, few species; catadromous

Order *Cyprinodontes*

- (1st) Amblyopsidae, cave fishes, etc.: E. North America; ca. 4 genera, 9 species
 (2nd) Cyprinodontidae, etc., top-minnows: the continental regions excepting the Australian; and some islands, including Celebes, Madagascar, and the Seychelles, and some West Indies and Bermuda; many genera & species
 (2nd) Poeciliidae, etc., viviparous minnows: Americas, including West Indies in part; many genera and species

Order *Salmopercae*

- (1st) Percopsidae, trout-perches: North America; 2 monotypic genera
 (1st) Aphredoderidae, pirate-perches: E. North America; one species

Order *Percomorphi*

- (1st) Centrarchidae, basses, sunfishes: North America; ca. 19 genera, 40 species
 (1st) Percidae, perches: cool N. hemisphere; 5 genera, 11 species in Eurasia; none in Pacific drainage of W. North America; ca. 34 genera, more than 100 species in E. North America
 (1st) Nandidae: Africa, Orient, South America; each region with one or 2 genera, each genus with one or 2 species
 (1st) Pristolepidae: Orient; 1 genus, ca. 4 species
 (2nd) Cichlidae: Africa, Syria, etc.; Madagascar, Ceylon, S. India; South & Central America to the Rio Grande; Cuba, Hispaniola; many genera and species
 (per) Gobiidae, etc., gobies: tropical and temperate seas, and fresh waters especially in the tropics; many genera and species; some fresh-water forms are catadromous, others resident
 (per) Atherinidae, silversides: tropical and temperate coastal seas and scattered fresh waters; 39 genera, about half of them confined to fresh water
 (1st) Anabantidae, Channidae (Ophicephalidae), Luciocephalidae; labyrinth fishes: Old World tropics and temperate eastern Asia; ca. 15 genera, numerous species

Order *Scleroparei*

- (per) Cottidae, sculpins, etc.: cool N. hemisphere, and one off the coast of Chile (Norman, 1938); many marine, a few resident in northern fresh waters; the related Comephoridae and Cottocomephoridae, with ca. 7 genera, 12 species, confined to Lake Baikal in Siberia
 (per) Gasterosteidae, sticklebacks: cool N. hemisphere; few genera and species, some marine, some entering or resident in fresh water

Order *Opisthomi*

- (1st) Mastacembelidae, spiny eels: Old World tropics and temperate E. Asia; 2 genera, numerous species; the related Chaudhuriidae, one species, known only from Inlé Lake, Burma

are absent in most of Australia, but not because of cold climate. In South America, a catfish of the family Pygidiidae reaches 47° 30' S., some 500 miles short of Cape Horn (Eigenmann, 1918, p. 269). It is probably the most southern true fresh-water fish in the world, but peripheral fishes occur in fresh water as far south as there is any. The ability of fishes to exist in very cold climates is due partly to the protection against cold afforded by deep water, but *Dallia* inhabits the shallowest sort of water on arctic tundras, and freezes solid in winter.

Great faunas of true fresh-water fishes are confined to the continents, excepting Australia, and to islands that have recently been parts of continents (Fig. 1). No fact in zoögeography is more striking than this. Some South American groups reach Trinidad, but not one of the many primary-division families of North or South America reaches the West Indies proper, although a few secondary-

division stocks do so. No true fresh-water fishes of Africa reach Madagascar, except again some secondary-division stocks. Some primary-division families of Europe and Asia reach the British Isles, Japan, Formosa, Hainan, and Ceylon; and many tropical Oriental families range over Sumatra, Java, and Borneo. Here, however, most of them stop. No primary-division fish reaches Celebes. Celebes does have a few secondary-division Cyprinodontes, but even they go no farther east. A few small cyprinids go beyond Java on the Lesser Sunda chain: 2 are known on Bali, 2 on Lombok, and one on Sumbawa; none is endemic (de Beaufort, 1913). A very small fraction of the Bornean fauna reaches the southern Philippines: 2 endemic genera of silurid catfishes are on Palawan and the Calamianes Islands; one endemic species of clariid catfish is on Mindanao; and certain cyprinids are on the Palawan-Mindoro chain and on Mindanao (Herre, 1928). These fishes belong to families of

Myers' *primary* division. Either they have crossed land bridges that most Bornean fishes failed to cross, or they have gotten over barriers of salt

gone beyond the limits of most fresh-water fishes in three separate directions: to Bali and Lombok, to Palawan, and to Mindanao, where it is the ap-

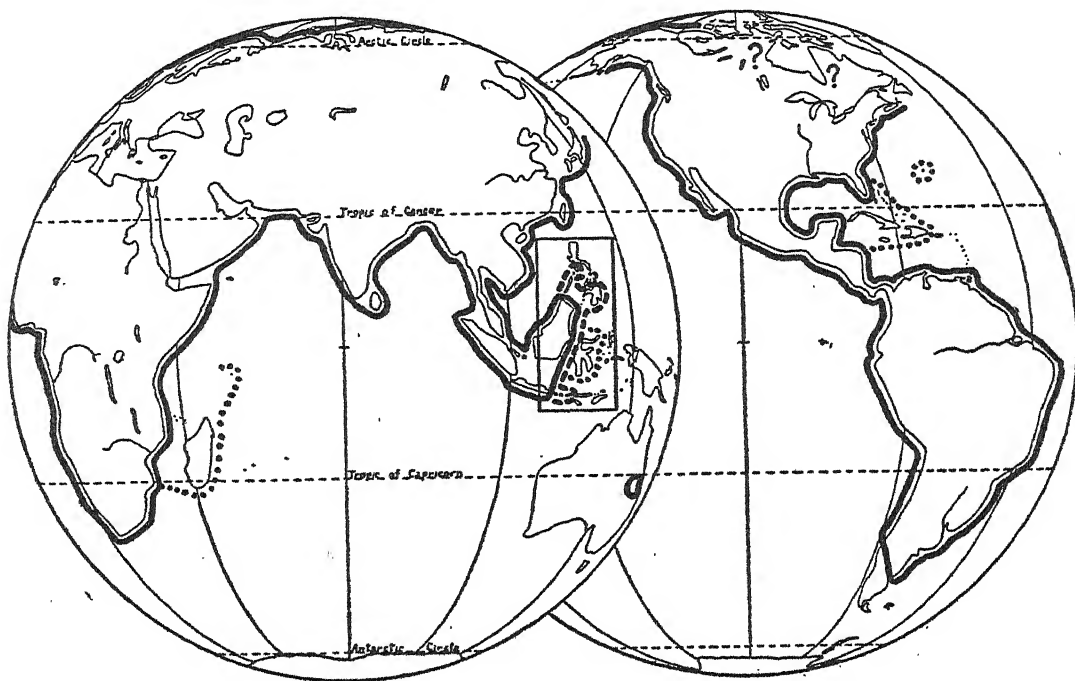
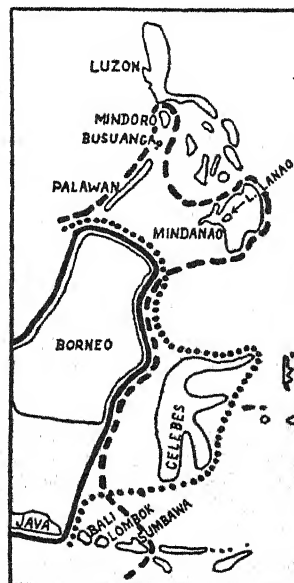


FIG. 1. LIMITS OF DISTRIBUTION OF PRIMARY- AND SECONDARY-DIVISION FRESH-WATER FISHES

- Limits of primary-division fishes; or, in East Indies, limit of main primary-division fauna
- - - Limit of primary-division stragglers in East Indies
- Limits of secondary-division fishes on islands

The occurrence of one primary-division fish, the ceratodontid lung-fish, in eastern Australia is shown. The occurrence of an osteoglossid in northeastern Australia and New Guinea is not shown; it is doubtful if this fish really belongs in the primary division.



water. One small cyprinid, *Puntius* ("Barbodes") *binotatus* (C.V.), which occurs in fresh water from Singapore through Sumatra, Java, and Borneo, has

parent ancestor of a whole fauna of cyprinids which has evolved in Lake Lanao (Herre, 1933). It is too much to suppose that accident has singled

out this one species three times; there is probably a discoverable reason why it has attained its present range. It would be most interesting to know its salt-tolerance! Possibly the few catfishes and cyprinids that have gone beyond Java and Borneo will have to be transferred to the secondary division, that of salt-tolerant fresh-water fishes. But they should not be allowed to obscure the main fact, that the great fresh-water fish faunas of the world are sharply bounded by old barriers of salt water, and that the few species that have got beyond the barriers are almost all known to tolerate salt water, or to be carried by man.

In Australia, far outside the limits of the great continental faunas, are two fishes of supposedly primary-division fresh-water families. The osteoglossid *Scleropages leichhardti* Günther, a large fish two or three feet long, inhabits rivers of tropical Queensland and New Guinea. Another species of the same genus lives in the Orient. This genus spans the gap between Asia and Australia in a way that no other living fresh-water fish does. The Osteoglossidae have been called ancient, but, known first in the Eocene, they are no older in the rocks than the Ostariophysi or many other fresh-water fishes, and their relationships do not suggest great antiquity. We do not know to what extent they can tolerate salt water. The African osteoglossid, *Clupisudis*, occurs in brackish water at the mouth of the Senegal, and a supposed osteoglossid is fossil in marine strata in the English Eocene. The Australian fish is not recorded from salt water (Longman, in letter), but it is not well known; it has been listed from New Guinea on the basis of one photograph of a specimen which was not preserved! Whether *Scleropages* reached Australia through river systems over an ancient land connection or partly through the sea I shall not try to say. It is surely a case which should be interpreted with caution.

The Australian lungfish, *Epiceratodus forsteri* (Günther), is known native only in the Mary and Burnett Rivers of subtropical southeastern Queensland. It is not directly related to the living lungfishes of Africa and South America, but to fossils which appeared in the Triassic and were cosmopolitan in the Mesozoic. It is a relict incomparably more ancient than the osteoglossids. It is the only undoubted relict of an ancient fresh-water family outside the limits of the great continental fish faunas.

Within the limits described above, fresh-water

fishes range along climatic zones more than along continuity of land. The north temperate zone and the tropical zone of the world have great, distinct assemblages of primary- and secondary-division families. The Arctic and the south temperate zone lack well defined faunas of strictly fresh-water families, but have many peripheral fishes. These too are zoned with climate. Peripheral salmonids and their allies dominate cold northern fresh waters; they occur southward through the north temperate zone, but enter the tropics scarcely or not at all. In the tropics, gobies are the commonest peripheral fishes, although they are not exclusively tropical; and many other tropical marine families occur in fresh water to some extent. In the south temperate zone, galaxiids are dominant. The genus *Galaxias*, with 40 or more species, ranges around the world in the cool southern hemisphere, chiefly in fresh water. There are species in Australia and Tasmania, Lord Howe Island, New Zealand, cold-temperate South America, and the Falkland Islands; and 2 species forming an endemic subgenus are on the southern tip of Africa. Other genera of the family are localized, within the range of *Galaxias*, on Tasmania and New Zealand and in Chile, and a species which Myers (personal communication) thinks may be an endemic genus sets the northern limit of the family on New Caledonia, just within the tropics. The family is considered to be of marine origin, just completing the process of establishing itself in fresh water. Some *Galaxias* still breed in the sea. One species which does so, *G. attenuatus* (Jenyns), enters fresh water with only a slight differentiation of races in southern Australia, New Zealand, and southern South America (Regan, 1905, p. 364).

Many marine fishes, too, are zoned with climate: the great shore-fish faunas of the tropics around the world are remarkably similar in many respects, and are relatively distinct from the temperate faunas immediately north and south of them (Myers, 1940). That so many peripheral and marine fishes, which can disperse through the sea, tend to be confined to one climatic zone or another shows that climate has a profound influence on their distribution. I think that climate probably has an equally profound influence on the distribution of true fresh-water fishes, although its importance is not often recognized.

For further discussion, I shall divide primary-division fishes into two groups: in one go all except

the order Ostariophysi; in the other, the Ostariophysi alone.

The distribution of non-ostariophysan, primary-division fresh-water fishes follows climate closely (Table 2). Ten families of them (not counting arctic Dallidae) are north temperate. All 10 are present in eastern North America. Only 4 of the 10 occur in North America west of the Rockies: 3 are represented there by single, relict, monotypic genera localized in different rivers (cf. Miller, 1946); the

(all shared with Africa and 2 also with the Orient). The 7 peculiar African families all belong to ancient or generalized orders, and include some strikingly archaic relicts. The 3 peculiar Oriental families are higher, spiny-rayed forms, perhaps of more recent, local origin. As compared with Africa, the Orient has notably few archaic fresh-water fishes.

The line between the north temperate zone and the tropics is crossed by few non-ostariophysan primary-division families. In America, none

TABLE 2

Distribution of existing non-ostariophysan primary-division fresh-water fishes

Numbers in parentheses are numbers of species, but are only approximations in the larger families. Arrows indicate the Oriental families that enter temperate eastern Asia. Central and western temperate Asia, not covered by this table, possess only one additional non-ostariophysan primary-division fish, a percid.

EUROPE	TEMPERATE E. ASIA	W. NORTH AMERICA	E. NORTH AMERICA
	Polyodontidae (1)		Polyodontidae (1)
			Amiidae (1)
Umbridae (1)		Umbridae (1)	Hiodontidae (2)
Esocidae (1)	Esocidae (2)(N. only)	Esocidae (1)(N. only)	Umbridae (2)
			Esocidae (5)
		Percopsidae (1)	Amblyopsidae (9)
			Percopsidae (1)
		Centrarchidae (1)	Aphredoderidae (1)
Percidae (10)	Percidae (2)(N. only)		Centrarchidae (40)
			Percidae (100+)
-----line between north-temperate-----and tropical faunas-----			
AFRICA	ORIENTAL REGION		SOUTH AMERICA
Archaic forms			
Lepidosirenidae (3)			Lepidosirenidae (1)
Polypteridae (13)			
Isospondyli			
Phractolaemidae (1)			
Pantodontidae (1)			
Gymnarchidae (1)			
Mormyridae (150)			
Kneriidae (3)			
Notopteridae (2)	Notopteridae (3)		
Osteoglossidae (1)	Osteoglossidae (1)		Osteoglossidae (2)
Higher, spiny-rayed forms			
Nandidae (1)	Nandidae (4)		Nandidae (2)
	Pristolepidae (4)		
Anabantidae (16)	Anabantidae (25)		
	Luciocephalidae (1)		
Channidae (3)	Channidae (20)		
Mastacembelidae (34)	Mastacembelidae (num.)		
	Chaudhuriidae (1)		

fourth (Esocidae) reaches western drainage only in Alaska. [The eastern trout-perch (Percopsidae), too, may reach the west coast of Alaska; it is reported from the upper Yukon by Cameron et al., 1947.] Only 4 of the 10 occur in Eurasia: the Esocidae and Percidae are widely distributed across northern Eurasia; the Polyodontidae and Umbridae are represented by single relict species in China and eastern Europe respectively. Sixteen families are tropical: 13 of them occur in Africa; 9, in the Orient (6 shared with Africa); and 3, in South America

crosses it; none even enters Central America. In Africa, some tropical families follow the Nile nearly to its mouth, and so enter the edge of the north temperate zone, but none occurs in truly temperate waters. Only in eastern Asia is there any overlapping of temperate and tropical groups. Of 3 temperate families in eastern Asia, none reaches the tropics, and all are in fact either relict (Polyodontidae in China) or confined to the far north (Esocidae in the Amur and northward; Percidae only north of the Amur). But of the 9 tropical

Oriental families, 3 enter the temperate zone: the Anabantidae and Mastacembelidae reach North China; the Channidae (Ophicephalidae), the Amur. These families lack endemic temperate genera, and there is little endemism even of species near their northern limits; and their temperate ranges are much smaller than, and continuous with, their great ranges in the Old World tropics. The indications are that, in eastern Asia, temperate families have withdrawn and tropical families have pushed northward into the temperate zone.

The non-ostariophysan fresh-water fishes have had diverse origins. Existing stocks of lungfishes and perhaps bichirs may have evolved continuously in fresh water, but each of the other main groups has probably come independently from the sea, although when and where they did so is unknown. Fossils show two things: first, that some families have existed in the north temperate zone since the Eocene, and that during the Tertiary they have tended to withdraw from Eurasia and from western North America and to survive in eastern North America, and the distribution of surviving forms (Table 2) strikingly confirms such withdrawal; second, that two families have withdrawn from still greater areas. The Osteoglossidae, whatever their origin, have withdrawn from the north temperate zone and have survived in the tropics during the Tertiary. Ceratodontid lungfishes, which apparently occurred over the whole world in the Mesozoic, have dwindled to one species, in two small Australian rivers.

The order Ostariophysi is characterized by the chain of Weberian ossicles which connects the air-bladder with the inner ear. This structure is thought to improve hearing and to be an adaptation to life in fresh water, and it is believed that the Ostariophysi, although probably derived from marine Isospondyli, had a single origin in fresh water in a single region, from which they have dispersed. This single order contains about seven-eighths of the true fresh-water fishes of the world: some 4,500 species in about 36 families. It contains also 2 families, the ariid and plotosid catfishes, with about 150 species, which have gone back into the sea, and some of them have re-entered fresh water in such remote places as Madagascar and Australia. Except for them, the representatives of the Ostariophysi have the same general limits of distribution as other true fresh-water fishes.

There are two suborders of the Ostariophysi.

One contains the catfishes, with about 22 fresh-water families, distributed as follows: in Africa, 6; in the tropical Orient, 9 (3 shared with Africa); in South America, 9 (all peculiar except that some range north into or through Central America). One of the families (Bagridae) common to Africa and the Oriental Region ranges north in eastern Asia to the Amur, another (Siluridae) characteristic of the tropical Orient occurs sparingly through temperate Eurasia north to the Amur and west to the Rhine, and a third tropical Oriental family (Sisoridae) is represented north to the Yangtse Kiang and in central Asia north of the Himalayas. There are some endemic species of these families in north temperate Eurasia, but apparently no endemic genera. Finally, the Ameiuridae are confined to North America south to Guatemala, but are apparently related to Old World bagrids. Fresh-water catfishes, then, are chiefly tropical. The four families represented in the north temperate zone are distributed or related as if they had come from southeastern Asia.

The other suborder of the Ostariophysi contains three "divisions." The first, the Characiformes, with 6 families, is confined to Africa and South and Central America, north to the Rio Grande. The second, the Gymnotiformes, with 4 families, is probably derived from the Characiformes and is confined to South and Central America north to Guatemala. The third, the Cypriniformes, contains 4 families.

The first family of the Cypriniformes is the Catostomidae, already discussed. This family occurs chiefly in North America south to Guatemala, but has one apparently relict and one immigrant species in eastern Asia. The Homalopteridae is all Oriental, north only to the Yangtse Kiang. The Cobitidae is chiefly tropical Oriental, but a few species occur north to the Amur, west over the whole width of Asia and Europe, and in northern Africa. Finally, the carp family, the Cyprinidae, the greatest of all fresh-water fish families, consists (according to Regan) of 3 subfamilies. Two of them are chiefly tropical Oriental but are represented also in temperate Eurasia and in Africa; the third is dominant in and almost restricted to the north temperate zone of Eurasia and North America, south to southern Mexico. The Cypriniformes that have reached tropical Africa seem to have done so along the southern edge of Eurasia, not through the colder temperate zone. Cyprinids appear to have spread from Eurasia, where they are fossil in

the Eocene, to North America, where they are unknown below the Miocene. In discussing the distribution of cyprinids I have used the classification of Regan (1922) rather than that of Nichols (1938) because the latter gives little distributional information.

Fossil Ostariophysi are known from many Tertiary deposits. They carry the history of the order back to the Eocene. Most of the Eocene fos-

treating during the Tertiary, and have come to be completely zoned with climate, except that three tropical families range northward into temperate eastern Asia. The Ostariophysi have had a single origin, have been chiefly expanding during the Tertiary, and, although some families are zoned with climate, others have spread extensively across climatic boundaries. The distribution of the latter families suggests radiation in all possible direc-

TABLE 3

Present distribution and apparent chief lines of dispersal of fresh-water Ostariophysi

Names in parentheses indicate presumed former occurrence of groups in regions where they no longer exist. Figures show numbers of families of characins and tropical catfishes in each region; figures in parentheses, numbers of families peculiar to each region. The table does not attempt to show *slight* invasions of the north temperate zone by certain tropical families (*e. g.*, by the Homalopteridae, which reach the Yangtse Kiang; and by a family of characins, which reaches the Rio Grande) nor *slight* invasion of the edge of the tropics by two temperate North American families (Ameiuridae and Catostomidae, both of which reach Guatemala).

<u>Temperate Eurasia</u>		<u>North America</u>	
Cyprinidae ----->		Cyprinidae	
Cobitidae^			
Catostomidae^|----->		Catostomidae	
Silurid catfishes^			
Bagrid catfishes^			
Sisorid catfishes^			
(Ameiurid catfishes)^|----->		Ameiurid catfishes	
- - - - <u>line between temperate and tropical faunas</u> - - - - -			
<u>Africa</u>		<u>Oriental Region</u>	<u>South America</u>
Cyprinidae <-----		Cyprinidae	
Cobitidae <-----		Cobitidae	
		Homalopteridae	
		(Catostomidae)	
		CYPRINIFORMES	
CHARACINS 2(1) -----		(CHARACINS) ----->	CHARACINS 5(4) + GYMNOTIFORMES 4(4)
CATFISHES 6(3) -----		CATFISHES 9(6) ----->	CATFISHES 9(9)

sils belong to existing genera, so the order probably dates from the Cretaceous. In Regan's time (1922) no fresh-water family of Ostariophysi was known fossil outside of its present range. One or two exceptions to this rule are known today, but the fossil record still suggests that the Ostariophysi are a chiefly expanding group, and so, I think, does the distribution of existing forms.

There are obvious points of contrast between the distributions of non-ostariophysan fresh-water fishes and of the Ostariophysi. The non-ostariophysans have had diverse origins, have been re-

tions from a main Tertiary center in the Oriental tropics (Table 3).

The secondary division, of somewhat salt-tolerant fresh-water fishes, contains three groups. The Lepisosteidae occur in eastern North America and Central America, north to the Great Lakes and south to Panama, and in Cuba; they are fossil in North America, temperate Asia, and Europe in the late Cretaceous and Eocene; they are an old north temperate family which has, apparently, pushed farther into the tropics than any other northern fresh-water fishes, but they have not reached

South America and do not compete with the main South American fish fauna. The Cyprinodontes, with several families, are characteristic of the tropics of the world, excepting the Australian Region, but they occur also north and south of the tropics well into the temperate zones, especially in America. Cichlids are numerous in Africa and

American lakes, and also of Central America and southern Mexico, where primary-division fishes are peculiarly few.

Obviously, the three divisions of fresh-water fishes tend to have complementary distributions. Peripheral fishes tend to replace true fresh-water ones toward the Arctic and in the south temperate

TABLE 4

Dominant groups of fresh-water fishes of main continental areas

This table is designed to show the geographic relationships of cyprinids to other dominant, presumably sometimes competing groups of fresh-water fishes. The criterion of dominance is number and diversity of species. Species of Cypriniformes are extraordinarily numerous and diverse in the Oriental Region, where they probably originated or at least attained dominance, and where they may have replaced several groups of fresh-water fishes which are still dominant in Africa and/or South America. From the Orient, the Cyprinidae has invaded and diversified in temperate Eurasia, where, as dominant fresh-water fishes, they have replaced all other families except peripheral ones. From the main zone of cyprinid dominance in the Orient and temperate Eurasia, cyprinids have spread probably comparatively recently to Africa and North America; on these continents they are numerous but not yet diverse, and they share dominance with numbers of other fishes. Cyprinids have not reached South America, where the locally dominant fresh-water fishes have radiated in isolation through the whole Tertiary. Cf. Table 2: note that the zone of cyprinid dominance is also a zone where many non-ostariophysan families are absent or represented only by relicts.

ZONE OF MIXED DOMINANCE	ZONE OF CYPRINID DOMINANCE	ZONE OF MIXED DOMINANCE	ZONE OF NO CYPRINIDS
	Temperate Eurasia (PERIPHERAL FISHES,) (northward) CYPRINIDAE	Temperate North America (PERIPHERAL FISHES,) (northward) AMEIURID CATFISHES CATOSTOMIDAE CYPRINIDAE (numerous but recent, not diverse) NON-OSTARIOPHYSANS (esp. perciforms)	
----- line between north-temperate and tropical faunas -----			
Africa ARCHAIC & GENERALIZED NON-OSTARIOPHYSANS CATFISHES CHARACINS CYPRINIDAE (numerous but recent, not diverse) CICHLIDAE	Oriental Region CATFISHES CYPRINIFORMES HIGHER NON-OSTARIOPHYSANS (esp. labyrinth fishes)		South America CATFISHES CHARACINS, ETC. CYPRINODONTES CICHLIDAE =====
			Australia (PERIPHERAL FISHES)

occur north to Syria and east to Madagascar, Ceylon, and southern India; they are numerous also in South and Central America and reach their northern limit in the Rio Grande, and occur on Cuba and Hispaniola. As a group, secondary-division fishes are characteristic especially of certain island, including Madagascar and some of the West Indies, and of isolated African and South

zone. Secondary-division fishes tend to be numerous where primary-division ones are few. Within the primary division, the distributions of cyprinids and of certain other related and unrelated fresh-water fishes are strikingly complementary (Table 4). Cyprinids and their immediate allies dominate the tropical Orient and, even more, temperate Eurasia, but are fewer in Africa

and North America and absent in Central and South America. As *dominant* fishes, they are complementary in the tropics to characins and cichlids, which occur entirely or chiefly in Africa and tropical America, and in the north temperate zone they are more or less complementary to the Catostomidae and certain non-ostariophysan families which are dominant in and nearly or quite confined to North America. That some of these complementary groups compete, and that spread of one may cause withdrawal of another, is hard to doubt. However, competition is apparently not at narrow lines but in large areas and over long periods of time.

The relationships of tropical fresh-water fishes, and the origin of those of South America, are special, intriguing problems. In the tropics there are three great faunas of fresh-water fishes, in Africa,

mary- and 2 secondary-division families are common to South America and Africa, and there is no common genus. Of course, South America lacks some African groups, including some ancient ones, and also lacks the Cypriniformes. In contrast to the all-pervading African relationship, there seems to be no direct relationship whatever between the South American families of fresh-water fishes and living, truly North American families, except in the salt-tolerant order Cyprinodontes.

Matthew (1915, pp. 297-299; 1939, pp. 127-130) believed that the main groups of fresh-water fishes have evolved in the north temperate zone, and that a succession of them has descended into the tropics and persisted there as relicts, but this belief is against the evidence. Matthew's statement of supposed fossil evidence is almost wholly a list of errors, as Myers (1938, pp. 351-2, with footnote 18)

TABLE 5
The groups of South American fresh-water fishes

Primary division, non-ostariophysans

1. Osteoglossidae: one family, also in Africa, Orient, Australia (perhaps salt tolerant)
2. Nandidae: one family, also in Africa, Orient
3. Lepidosirenidae: one family, also in Africa

Primary division, Ostariophysi

4. Catfishes: 9 families; other families in Africa, Orient, etc.
5. Characiformes, with derived Gymnotiformes: 9 families; characins also in Africa

Secondary division

6. Cichlidae: one family also in Africa to southern India
 7. Cyprinodontes: 2 principal families; Cyprinodontidae widely distributed, but dominant South American and African genera related; Poeciliidae also in North America
-

in the Oriental Region, and in South America. Africa has an old, diverse fauna, lacking no important tropical order, and alone possessing the ancient bichirs and several peculiar families of the Isospondyli. The tropical Orient has a fauna in part rather closely related to the African; 10 primary-division families and some genera are the same; but the Orient lacks most of the older African groups, the lungfishes, bichirs, and most of the African Isospondyli, and lacks also the more recent characins and, except in southern India, cichlids; and the Orient is uniquely rich in the Cypriniformes. South America has a fauna which is perhaps richest of all in endemic species, genera, and even families, but poorest in origins. South American primary- and secondary-division fresh-water fishes belong to only 7 basic groups (Table 5). All 7 are related in some way toward Africa. The relationships are apparently old; only 4 pri-

mary- and 2 secondary-division families are common to South America and Africa, and there is no common genus. Of course, South America lacks some African groups, including some ancient ones, and also lacks the Cypriniformes. In contrast to the all-pervading African relationship, there seems to be no direct relationship whatever between the South American families of fresh-water fishes and living, truly North American families, except in the salt-tolerant order Cyprinodontes. Matthew (1915, pp. 297-299; 1939, pp. 127-130) believed that the main groups of fresh-water fishes have evolved in the north temperate zone, and that a succession of them has descended into the tropics and persisted there as relicts, but this belief is against the evidence. Matthew's statement of supposed fossil evidence is almost wholly a list of errors, as Myers (1938, pp. 351-2, with footnote 18)

has shown. There is hardly a fossil fish that really supports Matthew's views. Among existing fresh-water fishes there has *not* been a general tendency for northern families to push into the tropics; on the contrary, tropical families seem to have pushed northward. And tropical fresh-water fishes have direct and simple relationships, ancient ones between Africa and South America which involve the whole South American fauna but only a part of the African, and more recent ones between Africa and the Orient. This is not a pattern of relicts; it is too orderly. The pattern suggests a passage of fresh-water fishes first between Africa and South America and later between Africa and the Orient.

Passage of fresh-water fishes between Africa and South America might conceivably have occurred in either direction. All of a limited South American fish fauna might have reached Africa; or part

of a larger African fauna, South America. I think that the latter is more likely, and that, probably in the Cretaceous, a few tropical fishes of a diverse African fauna reached remote South America and radiated to form the present South American fauna, in which one group, the characins plus gymnotid eels, has far outstripped its African relatives. This is just the sort of thing that does happen when a few fishes of a large fauna reach isolated waters.

I can only guess at the routes the fishes may have followed from Africa to South America. They may have gone partly through the sea, if they had a little salt tolerance, or they may have crossed an old Africa-South America land connection, if one existed. Otherwise, they passed through the northern hemisphere; but that need not mean that they originated there.

HYPOTHETICAL HISTORY OF DISPERSAL OF FRESH-WATER FISHES

The following is a tentative history of the dispersal of fresh-water fishes. I shall begin in the Cretaceous, assuming the existence then of a variety of non-ostariophysan fresh-water families, of diverse origin, mostly zoned with climate. During the Cretaceous, the order Ostariophysi originated in fresh water, probably in the Old World tropics, and split into catfishes and characins, and parts of the resultant Old World tropical fauna of non-ostariophysan fishes plus primitive ostariophysans reached South America. If they did so over existing continents, they probably went by way of eastern Asia, crossed to North America at a time of favorable climate, and followed the west coast of North America to Central and South America. Only those tropical fishes that had some toleration for coolness could follow this route, and even they might have been barred from most of the north temperate zone, not by physical barriers, but simply because they were tropical fishes. Two facts are worth remembering in this connection. Several existing families of tropical fresh-water fishes do range north through eastern Asia to the Amur, which is at the level of southern Alaska. And three notably cold-tolerant species of existing north temperate primary-division fishes did filter across a late, cold Bering bridge, as a few cool-tolerant tropical species may have filtered across an earlier, warmer bridge. Later, about the beginning of the Tertiary, the Catostomidae evolved presumably from characins in southeastern Asia, and catostomids and ancestral amejiurid cat-

fishes moved from Asia to North America. During the Tertiary, the Cyprinidae, evolving in turn apparently from the Catostomidae, radiated explosively in the Orient, flooded the whole of Eurasia, and entered Africa and North America. The cyprinids replaced many older fishes, including characins, cichlids, and most older fresh-water families in the tropical Orient, and most catostomids and several non-ostariophysan groups in temperate Eurasia. The destruction of the older fishes in the Orient and temperate Eurasia, and also in western North America and Central America, was furthered by geological and climatic changes, so that the old tropical fauna of the Cretaceous survived chiefly in Africa and, in a partial and derivative form, in South America.

This history is hypothetical. It agrees with many facts, but I shall not try to prove it by remarking them. I suggest that the reader review, with this history in mind, what has been said about fresh-water fishes in preceding pages, and what Regan (1922) says about the Ostariophysi. Regan should be read for his facts, not his theories.

This hypothesis assumes and stresses certain things. It assumes that climate is fundamentally important to fresh-water fishes, and that climatic zones have existed since the Cretaceous, oriented as now, but varying in intensity and in detail. It assumes that fishes compete, and that the spread of some families causes a retreat of others. It stresses the Old World tropics, and during the Tertiary especially the Oriental tropics, as the main center of the evolution and dispersal of fresh-water fishes, so far as there has been one main center. It stresses the north temperate zone as a filter bridge for tropical fishes, and not as their place of origin.

The distribution of relict fresh-water fishes remains to be discussed. There are no ancient relicts of the Agnatha or Chondrichthyes in fresh water. Existing fresh-water members of these classes appear to have come more or less recently from the sea. Among bony fishes, all the non-Teleostei (cf. Table 1) are phylogenetic relicts. They are few. In the primary division of fresh-water fishes are only the Polyodontidae, with one monotypic genus in China and another in eastern North America; the Polypteridae, with 2 genera, 13 species in Africa; the Amiidae, with a single species in eastern North America; lepidosirenid lungfishes, with one genus, 3 species in Africa and another, monotypic genus in South America; and ceratodontid lungfishes, with one species localized

in Australia. In the secondary division is only the Lepisosteidae, with one genus, 4 or 5 species in eastern North America, Central America, and Cuba. Of these fishes, only the Australian lungfish is geographically isolated. All the others live with great faunas of true fresh-water fishes, some in the full tropics, some in the north temperate zone. Some, notably the lungfishes, may be protected from competition with most other fishes by special adaptations and modes of life, but others are not. *Amia calva* L., although the only relict of an order

formation about amphibians, the most important single source is Noble (1931).

There are three existing orders of amphibians: the Apoda or caecilians, the Urodela or salamanders, and the Anura or frogs and toads.

Caecilians (Fig. 2) are almost strictly tropical. They enter the edge of the north temperate zone only in northern India; of the south temperate, only in southern South America. The order contains a single family, the Caeciliidae, of some 17 genera and 73 known species, distributed as fol-

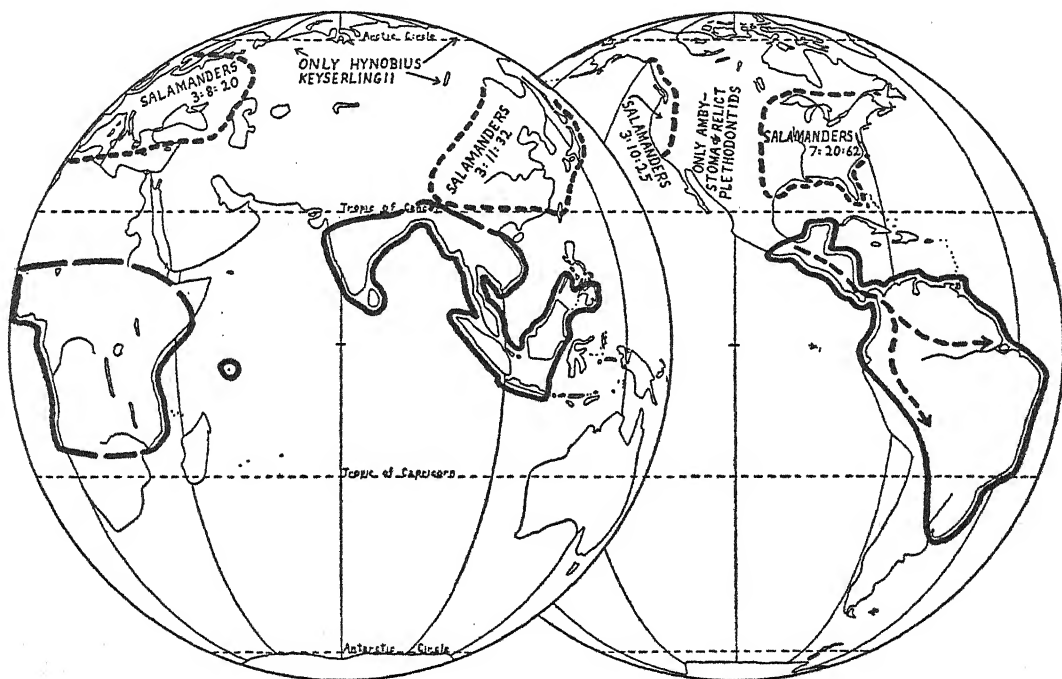


FIG. 2. GEOGRAPHICAL DISTRIBUTION OF CAECILIANS AND SALAMANDERS

— Approximate limits of distribution of caecilians
 --- Approximate boundaries of the four principal areas inhabited by salamanders in the north temperate zone; and routes of dispersal of *Oedipus* in Central and South America
 Numbers, as 3:8:20, are numbers of families, genera, and species of salamanders in the areas shown.

which dominated Jurassic seas and was once widely distributed in fresh water in the north temperate zone, exists without visible special protection in the present, rich fresh-water fish fauna of eastern North America.

AMPHIBIANS

I am indebted more than I can acknowledge in detail to Mr. Arthur Loveridge, Mr. Benjamin Shreve, Mr. Karl P. Schmidt, and Prof. E. R. Dunn for aid in obtaining and sifting information about amphibians and reptiles. Of published in-

formation about amphibians, the most important single source is Noble (1931). There are three existing orders of amphibians: the Apoda or caecilians, the Urodela or salamanders, and the Anura or frogs and toads. Caecilians (Fig. 2) are almost strictly tropical. They enter the edge of the north temperate zone only in northern India; of the south temperate, only in southern South America. The order contains a single family, the Caeciliidae, of some 17 genera and 73 known species, distributed as fol-

Living salamanders form 8 families, more than 40 genera, and nearly 200 species, plus additional subspecies. They are characteristic of the north temperate zone of the world (Fig. 2). *Hynobius keyserlingii* (Dybowski) of Siberia reaches the Arctic, but is perhaps the only salamander that does so. In Europe, salamanders reach about 63°N.; in western North America, hardly 60°; in eastern North America, perhaps not above 53°. Southwards, they about reach the Tropic in China and Formosa. Three European genera, 4 species (2 endemic) occur on the temperate north coast of Africa, and *Pleurodeles walii* Michahelles has been

where in the tropics, and there is none at all in the south temperate zone. Old records of species from Siam, Haiti, and the La Plata region of South America have proved to be errors.

Within the north temperate zone (Table 6), salamanders occur as follows: in Europe and adjacent parts of western Asia and North Africa, 3 families, 8 genera, about 20 full species; in most of western, northern, and central Asia, only *Hynobius keyserlingii*; in eastern Asia, including the eastern Himalayas, China, and Japan, 3 families, 11 genera, about 32 species; in western North America, from the lower corner of Alaska through California, 3

TABLE 6

Distribution of salamanders in the north temperate zone

All families are listed, and all genera that occur in more than one of the four areas. Figures in parentheses after families are numbers of genera and species; after genera, numbers of species. The numbers are in some cases only approximations.

EUROPE, etc.	EASTERN ASIA	W. NORTH AMERICA	E. NORTH AMERICA
	HYNOBIDAE (5, 20)		
	CHRYPTOBRANCHIDAE (1, 1)	.....	CHRYPTOBRANCHIDAE (1, 1)
		AMBYSTOMIDAE (3, 6)	AMBYSTOMIDAE (1, 9)
		Ambystoma (4)	Ambystoma (9)
SALAMANDRIDAE (6, 18)	SALAMANDRIDAE (5, 11)	SALAMANDRIDAE (1, 4)	SALAMANDRIDAE (1, 3)
Triturus (10)	Triturus (3)	Triturus (4)	Triturus (3)
	(Notophthalmus)	(Notophthalmus)	
PLETHODONTIDAE (1, 1)	.....	PLETHODONTIDAE (6, 15)	AMPHIUMIDAE (1, 1)
		Plethodon (5)	PLETHODONTIDAE (13, 38)
		Aneides (3)	Plethodon (11)
		Hydromantes (1)	Aneides (1)
Hydromantes (1)	.....	.....	PROTEIDAE (1, 7)
PROTEIDAE (1, 1)	.....	.....	SIRENIDAE (2, 3)
3 FAMILIES (8, 20)	3 FAMILIES (11, 32)	3 FAMILIES (10, 25)	7 FAMILIES (20, 62)

reported from one locality in West Africa, in the tropics south of the Sahara, but one may doubt whether it is native there. In America, *Ambystoma* follows the Mexican Plateau across the Tropic of Cancer; and *Oedipus* (in a broad sense), with many species, ranges from southern Mexico to Bolivia and Pará, but belongs to an otherwise north temperate family. This genus, *Oedipus*, has probably spread in the tropics chiefly along connected mountain systems, but it has invaded the lowlands of Central America extensively and those of northern South America a little. No salamanders other than those mentioned are known any-

families, 10 genera, 25 species; in west-central North America, including the Great Basin, Rocky Mountains, and Great Plains, only 2 wide-ranging species of *Ambystoma* and local, isolated populations of 2 or 3 species of plethodontids; in eastern North America, from the Ozarks and eastern Texas to the Atlantic, and from southern Canada to Florida, 7 families, 20 genera, 62 full species. It will be seen that north temperate salamanders are concentrated in four more or less separate areas: Europe, eastern Asia, western North America, and eastern North America.

A number of families and genera of salamanders

have discontinuous ranges (Table 6), and fossils show that some of them once occurred far outside their present ranges: *e. g.*, the cryptobranchid *Megalobatrachus* and the salamandrid *Tylotriton*, both now confined to eastern Asia, are fossil in Europe in the Miocene. Moreover, geographical relationships of different groups run in every possible direction among the four areas of distribution. Salamandrids link Europe and eastern Asia; *Hydromantes*, Europe and western North America; proteids, Europe and eastern North America; one group of *Triturus*, eastern Asia and western North America; living cryptobranchids, eastern Asia and eastern North America; various plethodontids and *Ambystoma*, western and eastern North America.

The geographical pattern which is formed when an old, diverse, wide-spread fauna is decimated and forced into restricted areas is called a relict pattern. It has two main characteristics. The first is discontinuity; related forms tend to occur in widely separated areas, and fossils may occur far outside the ranges of living forms. The second is diversity of relationships; geographical ties of surviving forms tend to be diverse and confused, reflecting chances of extinction and survival rather than directions of dispersal. The salamanders in the north temperate zone show such a pattern perhaps better than any other animals. Some fresh-water fishes of the north temperate zone (Table 2) show a similar pattern, but tropical fresh-water fishes do not, but show instead simple and direct relationships that probably indicate comparatively simple and direct dispersal, as said before. From the point of view of world zoögeography, the salamanders may be less important *per se* than for emphasizing, by contrast, the striking orderliness of the relationships of tropical fresh-water fish faunas.

The frogs and toads form a compact order for which there is no single, inclusive English name, but "frogs" may be extended in meaning to cover the order as a whole. In this broad sense, frogs are abundant on all the great continents and recent, habitable continental islands, and are native also on all the main West Indies, Madagascar, the Seychelles, the whole Indo-Australian Archipelago through the Philippine and Solomon Islands (and perhaps the Fiji Islands), Australia, Tasmania, and New Zealand. Upon the continents, species of *Rana* reach the Arctic across Eurasia and in North America; *Bufo* approaches the Arctic (to 65°N.) in Europe and may reach it in western

North America; and the hylid *Pseudacris* may reach it in western North America, although *Hyla* itself reaches only 57°N. in Europe and perhaps only 51° or 52° in America. Southwards, frogs reach the tip of South Africa, Tasmania south of Australia, New Zealand, and within a degree or two of the tip of South America, but they are unknown on Tierra del Fuego. As a group, however, they are primarily tropical. Of 36 families and subfamilies of them (Table 7), 26 are confined to the tropics or nearly so, and 4 or 5 others are more tropical than temperate in distribution. Of perhaps 1,800 known species, about 80 per cent are tropical; a little more than 10 per cent, north temperate; probably less than 10 per cent, south temperate.

The north temperate zone has no group of frogs at once peculiar to it and characteristic of all parts of it. The genus *Ascaphus*, sometimes placed in a family of its own, sometimes brigaded with *Liolopelma* of New Zealand, contains only one species, confined to cold brooks in northwestern North America, from northern California to southern British Columbia. The members of the Discoglossidae are mostly north temperate; there are 3 genera, 5 full species in Europe and the north temperate edge of Africa, and one of the European genera has two endemic species isolated in eastern Asia; but the family does not occur in western and central Asia nor in America; and there is an endemic genus on an island in the tropical Philippines. The subfamily Pelobatinae is confined to Europe, adjacent parts of Asia and the north coast of Africa, and North America south to the Mexican Plateau, but it is a small group and is absent in central and eastern Asia, although fossil in Mongolia in the Miocene; and other subfamilies of the Pelobatidae are isolated in the Old World tropics. No other family or subfamily of frogs is even nearly confined to the north temperate zone. Most north temperate frogs belong to three great, widely distributed genera: *Bufo*, including our common toads; *Rana*, including most of our typical frogs; and *Hyla*, including our tree frogs. Each of these genera occurs almost throughout the north temperate zone, but each is dominant in some part of the tropics too, and all belong to tropical families. A few other tropical frogs occur northward locally. In the Old World, they do so only in eastern Asia, where the brevicipitid *Kaloula* reaches Manchuria; *Rhacophorus*, northern Honshu in Japan; three other tropical genera, central

TABLE 7—continued

- h) *Rhacophorus* ranges north to central China and Japan.
- i) *Rhacophorus* ranges to Celebes, Timor.
- j) *Metopostira* reaches the Sulu Archipelago in the southern Philippines.
- k) *Microhyla* (*Gastrophryne*) enters north temperate in eastern United States; a second genus (*Hypopachus*) reaches southern Texas.
- l) Two genera enter north temperate in eastern Asia: *Microhyla* reaches central China, Japan; *Kaloula*, Manchuria.
- m) *Kaloula* reaches Celebes and Lesser Sunda Islands; *Microhyla*, Bali.
- n) *Oreophryne* ranges east and north to Bali, Celebes, and Mindanao.

China. In America, three tropical genera of leptodactylids and one of brevicipitids reach Texas and in one case southern Arizona too, and a second brevicipitid genus, *Microhyla* (*Gastrophryne*), extends north and east to Kansas, Indiana, and Maryland. This completes the list of frogs of the north temperate zone, excepting a few that may just enter its southern edge.

The distributions of all existing frog families are outlined in the following paragraphs, with reference particularly to the tropics and the south temperate zone.

Species of the Ascaphidae do not occur in or even near the tropics; the two genera are localized in opposite habitats in opposite temperate zones. Aquatic *Ascaphus*, with one species, is in northwestern North America. Chiefly terrestrial *Liopelma*, with two or three species, inhabits New Zealand. *Liopelma hochstetteri* Fitzinger and *archeyi* Turbott (the two may be forms of one species) are localized on the north side of North Island (Turbott, 1942; Stephenson and Thomas, 1945). They frequent open, fog-dampened ridges as well as brooks, and one or both forms lay eggs on the ground under stones and logs. Each egg is surrounded by a capsule of fluid in which the tadpole transforms into a froglet. *L. hamiltoni* McCulloch is known only from small Stephen Island, in Cook Strait just north of South Island; Stephen Island is without surface water at some seasons. These are the only native New Zealand frogs.

The members of the Pipidae form two subfamilies, one confined to Africa south of the Sahara; the other, to a part of tropical South America. They are the most aquatic of frogs.

The Discoglossidae has one endemic genus and species on Busuanga Island north of Palawan in the Philippines (Myers, 1943), but the family is otherwise confined to disconnected areas in the north temperate zone of the Old World.

The Pelobatidae has one subfamily, with 6 genera and numerous species, in the eastern tropi-

cal Orient (not in Ceylon or peninsular India) north into the edge of the temperate zone in China. Another subfamily, with 2 genera, 3 species, is confined to the Seychelles Islands between India and Madagascar. The third subfamily is virtually confined to the north temperate zone, as already described.

Leptodactylids are absent in the main part of the Old World tropics and in all northern regions, but are fossil in the Eocene of tropical India. One endemic genus, with few species, is in South Africa. Many genera and species are in the Australian and tropical American regions.

Species of the Hylidae are nearly or quite absent in a great area from Africa south of the Sahara through the Oriental Region, except at its northern edge. Species of *Hyla* are numerous in the Australian Region (Australia, New Guinea, etc.); few, across the north temperate zone of the Old World, from Spain and the north coast of Africa to China and Japan (a fossil *Hyla* is recorded from the Miocene of Europe); and numerous, in north temperate and tropical America. Most other genera of the Hylidae are confined to tropical America.

Species of the Atelopodidae may occur in Africa; at least one species is in the tropical Orient (Davis, 1935); many genera and species are in tropical America. The family needs study.

The Brevicipitidae (Microhylidae) (Parker, 1934) forms 7 subfamilies, all represented in the Old World tropics, but most of them strikingly localized or with discontinuous ranges (Table 7). They are few in South and East Africa; absent elsewhere in Africa; numerous in Madagascar, the Orient, and New Guinea; few in tropical northern Australia; and absent in temperate Australia. One subfamily, Microhyliinae, numerous in the tropical Orient, enters north temperate eastern Asia, reaching Manchuria. This is the only subfamily that occurs in America, where again it is chiefly tropical. One genus, *Microhyla* (*Gastrophryne*), is common to the Orient and America.

Most of its species in both areas are tropical, but one occurs north to central China; two, to Kansas and Indiana. The Phrynomeridae is related to the brevicipitids. The one genus, with few species, is widely distributed in Africa south of the Sahara.

The Bufonidae, Ranidae, and Rhacophoridae dominate both Africa south of the Sahara and the Oriental Region. Rhacophorids are numerous also on Madagascar; ranids, few there; bufonids, absent. The Ranidae alone of these families reaches the Australian Region, ranging through the whole Indo-Australian Archipelago to the Solomons (and to the Fijis, where they may have been carried by man), and at least one ranid reaches tropical northern Australia, but there is none in the main, temperate part of Australia. Of these three great families, only two genera range much beyond the limits of the Old World tropics, but these two are conspicuous. *Bufo* has many species not only throughout all of Africa and the Orient but throughout the whole north temperate zone and Central and South America; it is notably absent only in the Australian Region. *Rana* has many species throughout all of Africa and the Orient, into the tropical part of the Australian Region, through the whole northern hemisphere, and into Central America; and one species reaches northern South America. The genus is notably absent only in Australia below the tropics and in the southern half or more of South America.

Certain groups of frogs tend to be complementary either geographically or ecologically. Bufonids, ranids, and rhacophorids swarm in all habitats in Africa and tropical Asia; as dominant frogs they are complementary to leptodactylids and to *Hyla* in Australia and to these and other groups in South America. In the north temperate zone, *Bufo* and *Rana* are mostly terrestrial; *Hyla*, mostly arboreal. In the Australian Region, there is a three-way complementary arrangement: leptodactylids are mostly terrestrial (in the Australian Region) and are numerous in Australia, few in New Guinea; brevicipitids, also terrestrial, are numerous in New Guinea, few in Australia, and are in fact absent in temperate southern Australia; *Hyla*, mostly arboreal, is numerous in Australia and New Guinea (data from Parker, 1934 & 1940; and from my own field observations). In none of these cases do complementary groups meet at sharply defined boundaries; they overlap both geographically and ecologically. Presumably they compete, but they do so in broad zones rather than

on narrow battle fronts. Competition may occur also between frogs and salamanders. That the former jump and that the latter do not does not change the fact that the requirements of typical forms of both orders are about the same, and that, typically, both have aquatic, probably sometimes competing larvae.

Matthew (whose knowledge of frogs was slight) and also Noble and Dunn have urged a northern origin of frog faunas, but I think they have been too ready to force cold-blooded frogs into the pattern of warm-blooded mammals. There is no fossil to show that any frog now confined to southern regions has originated in the north temperate zone. No group of frogs is distributed as if it had evolved in the north and recently pushed into the tropics. The groups that come nearest to being peculiar to the north (*Ascaphus*, Discoglossidae, Pelobatinae) represent three of the four most primitive families of Noble's (1931) classification. They are relicts. Matthew's stated belief (1915, p. 295; 1939, p. 125) that archaic frogs are limited to peripheral and isolated lands, is plainly wrong. Dominant northern frogs, *Bufo*, *Rana*, and *Hyla*, seem all to have come from the tropics, and other tropical genera seem to have pushed wedges northward in eastern Asia and eastern North America. All these facts speak against a northern origin of frog faunas. Pleistocene glaciation hardly accounts for the paucity of northern frogs. Many fresh-water fishes and many salamanders survived the Pleistocene in eastern North America, and frogs are better able than fishes to move before glaciers, and are more adaptable than salamanders. It looks to me as if frogs have always been, as they now are, primarily tropical animals, and as if successive tropical groups have invaded the north temperate zone.

Some persons have imagined spectacular land bridges in the southern hemisphere to account for frog distributions. The members of the aquatic Pipidae do link Africa and South America, but they parallel the distribution of fishes they live among, and I have tried to show that the fishes need not have crossed a direct land bridge. The Leptodactylidae and *Hyla* are dominant on South America and Australia, but they occur and are fossil in other places, and they are not on New Zealand. The presence on New Zealand of a different, primitive frog suggests that the leptodactylids and *Hyla* did not pass that way. Frogs, in my opinion, have required no extraordinary land bridges

and provide some evidence against them. [The latest attempt to explain frog distributions in terms of great land bridges is by Metcalf (1940), who has tried to correlate the distribution of frogs with that of their opalinid parasites. The attempt is not very successful, partly because of failure to use an up-to-date classification of frogs. What Metcalf says in 1940 is not very different from what he said in 1923, and what he said then has been adequately criticized in two papers written expressly for the purpose by Noble (1925) and Dunn (1925).]

HYPOTHETICAL HISTORY OF DISPERSAL OF AMPHIBIANS

Frogs probably originated in the Triassic or earlier and are definitely known from the Jurassic. Salamanders and caecilians may be equally old, but the former have not been found before the Lower Cretaceous (of Europe), and the latter are not surely known as fossils.

Frogs are descended from amphibians that had ribs and tails. Of existing frogs, the Ascaphidae alone retains both ribs and tail-wagging muscles; the discoglossids are ribbed as adults; pipids, as larvae; pelobatids lack free ossified ribs but have other primitive characters. These four families, although not directly related, probably represent stages in the evolution of higher frogs. Their distributions are somewhat correlated with their places on the evolutionary scale.

The hypothetical history begins in the Cretaceous, with salamanders in the north temperate zone, caecilians in the tropics, and frogs principally in the tropics of the Old World. Later changes chiefly involved the frogs. What is said here about the movements of frog families will be best understood if reference is made to the descriptions of present distributions of the families, above (p. 17).

Probably during the Cretaceous, members of the primitive Ascaphidae, once present in the tropics, at least in the Old World, withdrew into the temperate zones. Probably also in the Cretaceous, members of the aquatic Pipidae got from the Old World tropics to South America in company with fresh-water fishes. If the fishes filtered through the north temperate zone, so may have the pipids, and so too may have caecilians. Perhaps later, the Discoglossidae withdrew from the Old World tropics into temperate Eurasia, leaving a rear-guard in the Philippines. And the Pelobatidae

may now be withdrawing northwards from the Old World tropics.

Most higher frog families (according to my hypothesis) have originated in the Old World tropics, have dispersed from there, and in the case of the older families have begun their extinction there with the rise of later groups, mostly during the Tertiary. Leptodactylids, now surviving in South Africa and the Australian and tropical American regions, are pointedly fossil in the Eocene of India. *Hyla* and the Hylidae fit this pattern as they do no other, assuming that South America has been a secondary center of their evolution. The Atelopodidae, apparently relict in the Orient but numerous in tropical America, may fit the pattern but are poorly known. Brevicipitids are in a less advanced stage of the cycle. Although still numerous in parts of the Old World tropics, they have broken into retreating or isolated subfamilies. They show clearly how an Old World tropical family can filter through the north temperate zone to the New World tropics. The Bufonidae, Ranidae, and Rhacophoridae now dominate all frog habitats in the main Old World tropics; and two genera of them, both notably cold-tolerant, have spread apparently recently over most of the rest of the available world.

This hypothesis stresses for amphibians the same factors that were stressed previously for fresh-water fishes: climate, competition, the Old World tropics as a center of evolution and dispersal and of extinction, and the north temperate zone as a filter bridge for tropical groups. The parallel between distributions and apparent histories of amphibians and of fresh-water fishes is striking, allowing for their obvious differences of habitat and means of dispersal. Caecilians and salamanders, like non-ostariophysan primary-division fishes, are mostly zoned with climate, the one group in the tropics, the other in the north temperate zone. Frogs, like the Ostariophysi, are partly zoned, but some of them, like the Cyprinidae among the Ostariophysi, have radiated apparently from the Old World tropics over much of the rest of the world. That this parallel is real and not just a matter of parallel hypotheses will, I think, be granted by anyone who will study the facts presented in preceding pages.

Relict amphibians parallel relict fresh-water fishes. Caecilians and salamanders must be ancient, but they include no uniquely archaic species in isolated places. These orders survive chiefly

in the main continental tropics and in the north temperate zone respectively. The Ascaphidae, Discoglossidae, Pipidae, and Pelobatidae are phylogenetic relicts among frogs, but only one genus of them, *Liopelma* of New Zealand, is geographically isolated. It is comparable to the lungfish in Australia. Other relict frogs, like relict fresh-water fishes, are about evenly divided between the full tropics and the north temperate zone: the tropical Orient has certain discoglossids and pelobatids; Africa and South America, pipids; the north temperate zone, an ascaphid, discoglossids, and pelobatids.

REPTILES

Existing reptiles are placed in four orders: the Rhynchocephalia, Crocodilia, Chelonia, and Squamata; and the last is divided into two suborders: the Lacertilia and Serpentes.

Rhynchocephalians were cosmopolitan in the early and middle Mesozoic, but are not known fossil above the Lower Cretaceous. Nevertheless, one species, *Sphenodon punctatum* Gray, still exists. It is known only from New Zealand, where formerly it was common on both main islands, but now survives chiefly on a few coastal islets. It frequents sandy and rocky places, often by the sea; it likes to lie in water, and swims well; and adults can live for months without food or fresh water. That any rhynchocephalian should exist is astounding, but that such an animal as *Sphenodon* has reached New Zealand is less surprising than that a frog has done so.

Existing crocodilians form one family of 9 genera, 25 species (Schmidt, 1944). They occur in the tropics on all continents and major islands, and locally in the warm edges of both temperate zones. Their present northern limits are set by the two living species of *Alligator*, one in the lower Yangtze Kiang, the other in southeastern United States north to the Carolinas. The family forms three poorly defined groups. Fossils show that all three were present on northern continents in the Eocene, and crocodile and alligator types were common there in the early Tertiary. They were present on southern continents at the same times (Romer, 1945, p. 222).

Recent, non-marine Chelonia, or turtles, form about 10 families, 57 genera, and more than 200 species. They are numerous in the tropics and in parts of the temperate zones. An *Emys* reaches 60°N. in Europe, but no other European turtle

reaches even 50°. A *Trionyx* is common in the Middle Amur at about 50°, but no other Asiatic turtle occurs north of about 40°, and a great part of interior and northern Asia is without turtles. In America, the most northern turtle, a *Chrysemys*, reaches about 51° in British Columbia and Manitoba, 49° or 50° above Lake Superior, and perhaps only 47° farther east. Southwards, turtles reach the tip of Africa, southern Australia but not Tasmania, and northern Argentina in South America. Within these limits they occur on all continents, most continental islands, and some not too remote oceanic islands, but not on New Zealand. (Marine turtles are disregarded in this discussion.)

North temperate turtles include a few peculiar genera: *Clemmys*, with 2 species around the Mediterranean (one of them recorded also from Senegambia, perhaps in error), 5 in eastern Asia (south to Hainan), one on the west coast of North America, and 3 in eastern North America; *Emys*, with one species in Europe and the Mediterranean region and one in eastern North America; and 3 or 4 other genera confined to eastern North America. But other genera and all families of north temperate turtles occur also in the tropics.

Fresh-water turtle families are distributed as follows: Emydids, "common turtles," are numerous in the Orient (17 genera, 38 species, mostly in the eastern Oriental tropics) and in temperate eastern North America (9 genera, 29 species), and a few occur elsewhere around the north temperate zone, and in Central and South America and some of the West Indies. Side-neck turtles, the Pelomedusidae and Chelyidae, are in Africa south of the Sahara and in the Australian Region (places where emydids are probably absent) and in South America (where emydids are few and probably recent). Pelomedusids actually occur only in Africa (including Madagascar, etc.) and South America; chelyids, in South America and Australia. The pelomedusid genus *Podocnemis* now exists only in Madagascar (one species) and South America (about 6 species), but is fossil in Africa in the Pleistocene and occurred on all continents except Australia at the beginning of the Tertiary. The trionychids, soft-shelled turtles, are in Africa with the side-neck pelomedusids and in the Oriental tropics with emydids; and *Trionyx* occurs also up the east coast of Asia to the Amur and in eastern North America. The single surviving species of the related Carettochelyidae is confined to New Guinea. The chelydrids and kinosternids, the snapping-

and musk-turtles respectively, are in eastern North America, Central America, and parts of northern South America. The two remaining families of fresh-water turtles, each with one existing species, are the *Platysternidae* in the tropical Orient and the *Dermatemyidae* in Central America.

Turtles have left a comparatively good fossil record. They appeared in the Triassic. Some existing fresh-water families were wide-spread in the Cretaceous. I can add nothing to what Simpson (1943) has recently said about their early distribution. During the Tertiary, two principal events occurred among them. First, side-neck turtles, which were cosmopolitan at the beginning of the Tertiary, withdrew from the north temperate zone and from the Oriental Region, and some other fresh-water turtles made extensive withdrawals from the same regions (cf. Simpson, op. cit.). Second, the *Emydidae*, whose members are fossil probably only within the present range of the family and only in the Tertiary, evolved and dispersed in just those areas from which other turtles withdrew. Two clues suggest that the emydids originated in the tropical Orient and spread to a secondary center of evolution in temperate eastern North America. They show much generic endemism in the Orient, less in North America, none in tropical America. And the American forms are concentrated in the cooler climate, as if their ancestors had filtered across a cool land bridge.

Recent terrestrial turtles, excepting a few aberrant emydids, belong to the *Testudinidae*. The principal genus, *Testudo*, occurs in the tropical and warm temperate areas of all continents except Australia. Giant species of *Testudo* now exist, or have existed within historic times, also on Aldabra, the Seychelles, Réunion, Mauritius, and Rodriguez Islands in the western Indian Ocean, and on the Galapagos Islands west of South America, and one was on Cuba in the Pleistocene. Some of these islands are oceanic. To reach the more remote of them, *Testudo* probably crossed ocean gaps of more than 500 miles.

Extinct, terrestrial, giant, horned turtles of the family *Meiolaniidae* (Simpson, 1938) lived in southern South America at the beginning of the Tertiary, and on eastern Australia, Lord Howe Island, and Walpole Island southeast of New Caledonia, in the Pleistocene, but are not known to have existed anywhere else. Lord Howe and Walpole Islands are beyond the limits of all other flight-

less terrestrial vertebrates except lizards; the presence of the turtles there indicates that they could cross ocean gaps. Matthew (1915, p. 283; 1939, pp. 113-114) has suggested that, in some warm period, they spread across an Antarctic archipelago as *Testudo* has spread across the islands of the western Indian Ocean, and this is still probably the best guess to account for their unique distribution.

The *Lacertilia*, or suborder of lizards, forms about 21 existing families (Camp, 1923), more than 300 genera, and nearly 3,000 recognized species. Lizards occur on the suitable parts of all continents and most islands. They swarm in the tropics, but some range far into the temperate zones. The northernmost lizard, *Lacerta vivipara* Jacquin, reaches 70°N. (well above the Arctic Circle) in Scandinavia, and at least 64° in western Siberia and 53° on the east coast of Siberia. It is the only viviparous (or, strictly, ovoviviparous) species of the family *Lacertidae*. Second among northern lizards is the related but oviparous *Lacerta agilis* L., which reaches 61°N. in Europe. In western North America, three lizards of three different families reach about 51°N. in southern British Columbia; two are viviparous; one, oviparous. In eastern North America, oviparous *Eumeces fasciatus* (L.) ranges farthest north, but reaches only 46° or 47° in the Great Lakes region and only slightly above 42° on the Atlantic coastal plain. Southwards, many lizards reach the tip of Africa; some, Tasmania; geckos and skinks, both islands of New Zealand; and one genus of the *Iguanidae*, Tierra del Fuego below South America. New Zealand geckos are the only viviparous *Gekkonidae*, but New Zealand skinks lay eggs. I do not know the habits of other southernmost lizards.

North temperate lizards are not very different from tropical ones. All widely distributed northern forms belong to families that are also tropical, and many belong to tropical genera. *Lacerta*, for example, ranges from the Arctic to tropical Africa. The only exclusively north temperate lizard family may be the *Anniellidae*, with one genus, 2 species, confined to the southern half of California and northern Lower California; it is obviously a localized rather than a characteristically temperate group. Some genera of other families are confined to parts of temperate Eurasia or temperate North America, but every genus common to both occurs also somewhere in the tropics. The nearest to a truly Holarctic lizard

genus is probably the anguid *Ophisaurus*, with one species in the Balkans, southwestern Asia, and temperate North Africa; possibly an additional endemic species in North Africa; two or three in the eastern Himalayas, Burma, southern China, and Formosa; one in eastern North America; and one in the mountains of Borneo. The old Bornean record is confirmed by a fresh specimen from Mt. Kinabalu in the Museum of Comparative Zoölogy.

The distribution of lizard families, so far as it can be stated in a few words, is this: The great families Gekkonidae and Scincidae are tropicopolitan and range for varying distances into both north and south temperate zones. The Iguanidae and the Agamidae are mutually related and complementary: the Iguanidae, with two relict genera on Madagascar and one on Fiji, is numerous throughout the Americas; the Agamidae is numerous on all Old World continents, but does not extend to Madagascar, nor to Fiji, nor to America. The Lacertidae, numerous through Africa and Eurasia, and the Teiidae, numerous through the Americas, are mutually related. Members of the Anguidae are scattered in the north temperate zone of the Old World and in the tropical Orient, and are widely distributed in temperate and tropical America. Amphisbaenids occur in Africa north to Spain and southwestern Asia, and in tropical America north to Lower California and Florida. Varanids occur through the Old World in the tropics and some warm temperate areas, excepting Madagascar but including Australia. Chamaeleontids are numerous in Africa and Madagascar, and outlying species reach the Seychelles, southern Spain, the southeastern Mediterranean, southern Arabia, Socotra Island, and peninsular India and Ceylon. The Gerrhosauridae is found in Africa and Madagascar; the Cordylidae (Zonuridae), only in Africa. The Pygopodidae, with some 8 genera, 14 species, is the only lizard family confined to the Australian Region. It is not an especially archaic family. The remaining families are all small and localized: the Feyliniidae, Dibamidae, and Anelytropsidae are degenerate, skink-like lizards of West and South Africa, Indo-China to New Guinea, and southern Mexico respectively; the Shinisauridae is known only in South China; the Anniellidae, in Southern and adjacent Lower California; the Helodermatidae, in southwestern United States, Mexico, and Borneo; the Xantusiidae, from southwestern United States to Panama, and in Cuba;

and the Xenosauridae, in Guatemala and southern Mexico.

Lizards have existed since the Jurassic, but their fossil record is poor. The Gekkonidae, the most numerous and perhaps the most archaic of existing lizards, are unknown fossil. Fossil scincids are few and unsatisfactory. Members of the "Iguania" (Iguanidae + Agamidae + Chamaeleontidae) are fossil in Europe, Asia, and North America back to the Upper Cretaceous, but their earlier remains are not surely assignable to families (Camp, 1923, pp. 307-312). Lacertids have been in Europe since the Eocene, but the record of an African genus, *Nucras*, in Baltic amber may be false; there is reason to think that the supposed fossil is really an existing African species embedded in modern East African copal (Loveridge, 1942, pp. 338-340). The Amphisbaenidae, which does not now range north of Spain and Florida, occurred in the early Tertiary in North America north to Wyoming and South Dakota, and apparently also in Mongolia (Gilmore, 1943). Varanids, now confined to the Old World, are in the Upper Cretaceous and Eocene of North America as well as of Eurasia, and *Varanus* was in Europe, a little northwest of its present range, through much of the Tertiary. Anguids were in Europe, Asia, and North America in the late Cretaceous and early Tertiary; forms close to *Ophisaurus* have been in Europe since the middle Tertiary. *Heloderma* occurred north to Colorado in the Oligocene. This brief list of facts is derived chiefly from Camp's (1923) cautious summaries. Obviously, some lizards have withdrawn from some parts of the north temperate zone during the Tertiary. In only one case can much more be said: the Iguanidae was probably once cosmopolitan, and the Agamidae has apparently been derived from it and replaced it on Old World continents; but this fragment of history is derived more from the distribution of existing forms than from any fossil.

The Serpentes, or snakes, form only about 11 families, but in genera (about 300) and species (about 2,600) they are almost as numerous as lizards. They occur on all habitable continents, most close-lying islands, and a few not too isolated oceanic islands, including the Mauritius group and the Galapagos, but not New Zealand. The majority are tropical, but they are common enough in the temperate zones. In the Old World, *Vipera berus* (L.), which is viviparous, just enters the Arctic, reaching 67°N. in Scandinavia; it or its repre-

sentatives reach 64°N. in Russia, 60° in Siberia, and 55° on the east coast of Siberia; it is the most northern snake. *Natrix natrix* (L.), which is oviparous, is a close second, reaching 65°N. in Scandinavia. In North America, viviparous garter snakes, *Thamnophis*, reach at least 56°N. in British Columbia and 52° in the east. Other snakes, including both viviparous and oviparous forms, reach only about 51° in British Columbia, and probably not that in the east. Southwards, snakes are numerous to the tip of Africa; three elapids reach Tasmania; Schmidt (in letter) thinks the southern limit in South America is probably set in Santa Cruz Province, southern Argentina, by *Trimersurus ammodytoides* Leybold, a probably viviparous viper.

The north temperate snake fauna is poorly defined. All northern snakes belong to tropical families; many, to tropical genera. *Vipera*, which includes the northernmost snake, occurs also through the tropics of Africa and Asia. There is probably no truly Holarctic snake genus. Some genera are confined to parts of temperate Eurasia or temperate North America, but every well defined genus that occurs in both occurs also somewhere in the tropics. Schmidt (1946) cites *Ophedryas* as confined to eastern Asia and eastern North America, as it is, but there are more species of the genus in the tropics of northern Indo-China than in any temperate area. *Coluber* in a very strict sense (Inger & Clark, 1943) is confined to temperate North America and northeastern Asia, but it is a weakly defined genus; it is perhaps a minor group which has recently crossed a Bering land bridge rather than a genus peculiarly adapted to north temperate climates.

The families of snakes are distributed as follows: the Typhlopidae, burrowing "blind snakes," are tropicopolitan and occur also in some warm temperate areas. A second family of "blind snakes," the Leptotyphlopidae, is confined to Africa and southwest Asia and tropical and warm temperate America. The burrowing Uropeltidae, with 7 genera, 43 species, is confined to peninsular India and Ceylon. The Anilidae consists of one small genus in the Oriental tropics and another in South America. The monotypic Xenopeltidae is Oriental. The Boidae, including the giant constricting snakes, forms two subfamilies. The Boinae is represented on Old World continents by only terrestrial, more or less burrowing *Eryx*, which ranges across temperate Asia into North and tropical East

Africa; but two monotypic genera occur on Madagascar; two more, on Round Island off Mauritius; and *Enygrus* inhabits New Guinea and other islands in the eastern Indo-Australian Archipelago, and east to Fiji and Samoa. In America, one terrestrial genus of the Boinae occurs through western United States north to southern British Columbia, and another is confined to California and neighboring areas; but the subfamily is best developed in South and Central America and the West Indies. The Pythoninae occurs in the tropics and some warm temperate regions of all Old World continents and major islands excepting Madagascar, but including Australia; and one endemic genus is in Central America. Note that, in the Old World, the only place where boas occur in open competition with pythons is on New Guinea and neighboring islands. The egg-eating Dasypeltidae has one genus and species in India, another in Africa. The Colubridae, which includes about two-thirds of all snakes, is a nearly cosmopolitan family but has few members in northern and eastern Australia and none in southern and western Australia. Two subfamilies of colubrids, the Acrochordinae and Homalopsinae, with together 12 genera, about 30 species, are fully aquatic; they inhabit fresh and salt water from the Orient to northern Australia. The Elapidae, including cobras, coral snakes, etc., occurs throughout the tropical and some warm temperate regions of the world, but is most numerous in Australia. Most of the Australian species are small and inoffensive; they are poisonous snakes, but they correspond in habitat and behavior to the harmless Colubridae which dominate the rest of the world. The Hydrophiidae, sea snakes, are numerous from the Orient to northern Australia; one species reaches the east coast of Africa, and one (the same one), the west coast of America; there is none in the Atlantic. The Viperidae forms two subfamilies: the Viperinae, or typical vipers, of Africa and Eurasia; and the Crotalinae, or pit vipers, of eastern Europe, Asia, and the Americas. Both subfamilies occur in tropical as well as temperate Asia and on parts of the Indo-Australian Archipelago.

Fossil snakes appear in the Cretaceous. Boids were very widely distributed in the late Cretaceous and Eocene. Colubrids are unknown until the Oligocene, and the few fossils are not important geographically. Elapids are known, before the Pleistocene, only by *Palaeomaja* in the Miocene and Pliocene of France; elapids no longer occur in

Europe. Viperids appear in the Miocene. *Bitis*, a genus of vipers now confined to Africa and Arabia, is recorded from Europe in the Pliocene. Most other snake families are unknown in a fossil state. This scanty record reveals little of the geographical history of snakes, and only a little more can be deduced from their present distribution. Among the Boidae, the Boinae were probably once cosmopolitan, and the Pythoninae are probably derived from them and have nearly replaced them on Old World continents. This is, I think, suggested by the distributions of both fossil and living forms. The boas are retreating toward Madagascar and Fiji just as iguanid lizards have done.

It is a curious fact that all families and almost all subfamilies of snakes occur in the Oriental Region, although some just enter its edge (Smith, 1943). The Orient has been a crossroads in the dispersal of snakes, if not a chief center of their evolution. The principal groups of aquatic snakes, both fresh-water and marine, are all in or around the Oriental Region, which has probably been their place of origin.

HYPOTHETICAL HISTORY OF DISPERSAL OF REPTILES

There is no distinct, generally distributed, exclusively north temperate reptile fauna. Characteristic northern reptiles all belong to tropical families; many, to tropical genera. Apparently reptiles have not often become thoroughly adapted to temperate climates, nor have they persisted and evolved in them over long periods of time. Fossils show that some existing tropical reptiles were once widely distributed in the north, but where the record is good, as among crocodilians and some turtles, it appears that the old groups were really more or less cosmopolitan rather than northern. It looks as if reptiles have evolved chiefly in the

tropics, and as if various tropical groups have spread into the north temperate zone, and have sometimes died out there later. Only rarely is it possible to trace the history of single families within this main pattern. Emydid turtles probably arose in the Oriental tropics during the Tertiary, and their radiation in the Orient and the north temperate zone is significantly correlated with the withdrawal of some other turtles, especially the side-necks. The iguanid-agamid lizards and the boid snakes seem each to have been a cosmopolitan group in which a new family or subfamily has arisen on Old World continents and completely or nearly replaced the original stock there. The principal existing groups of aquatic snakes apparently originated in the Oriental tropics during the Tertiary. I see no profit in guessing here about other families. So far as the evidence goes, the Old World tropics may have been the main center of evolution and dispersal of the great families of existing reptiles, if there has been any main center, but the evidence is much less than in the cases of the ostariophysan fresh-water fishes and the frogs.

Sphenodon, the only surviving rhynchocephalian, isolated on New Zealand, is a phylogenetic and geographical relict. No uniquely archaic species exist in other reptile orders. Turtles as a group are relict; they have existed practically unchanged since the Triassic; they are most diverse in the tropics. Crocodilians too are a relict group; they date from the late Triassic, and are the only surviving archosaurs. They are all in or near the tropics. Note that Australia has *not* been a refuge for archaic reptiles and amphibians. The continent does lack some recently dominant families, but it has no peculiarly primitive reptiles and none of the four most primitive families of frogs.

(To be concluded)



SCHOOLING BEHAVIOR IN FISHES

By JAMES E. MORROW JR.

Osborn Zoological and Bingham Oceanographic Laboratories, Yale University

INTRODUCTION

AN OFTEN observed but still little understood phenomenon in the social behavior of fishes is the school. This may range from a chance grouping of individuals brought into a given locality by some external factor or factors not concerned with relationships between individuals, to a closely-knit cohesive group, in which there appears to be a definite centripetal influence existing between fish and fish. In this review, groups of the former type will be designated as aggregations, those of the latter type as schools.

In connection with the school, a number of questions, as yet largely unanswered, have arisen. For example, one wonders as to the nature of the attractive forces that must exist between fish and fish to lead to the formation of schools. What factors operate to produce a school, to maintain it as a unit, or to disrupt it? What is the value or function, if any, of the school in contrast to a solitary mode of life? Parr (1937) has suggested that "self-recognition" and the ability of a fish to "recognize" others as similar to itself cannot be involved in the schooling behavior of such fishes as the mackerel, and postulated that the reaction is based upon an "automatic mechanism of association." Breder and Nigrelli (1935) have attempted to explain the phenomenon upon a mechanical basis, not involving problems of recognition. The problems to be faced are those of defining the adequate stimuli (Lashley, 1938) and of determining the physiological factors involved in the schooling response.

Parr (1927) was the first of modern investigators to attempt an analysis of schooling behavior in fishes. Previous to his publication, there existed an almost total blank of fifty years, at the beginning of which Newman (1876) had quoted Kent's report that schools of herring in aquaria broke up at night but re-formed with daylight. At that time it was suggested that the schools broke up because of a nocturnal feeding instinct which dominated the schooling instinct.

Parr classified aggregations as occasional and permanent, devoting his analysis to the latter. He showed that these permanent schools are characterized by a high degree of stability and independence from external influences, indicating the existence of dominating factors within the school and/or the individuals which compose it. This view is supported by the facts that, among schooling fishes, newly-hatched individuals will school immediately, before they can possibly have learned that schooling is in any way advantageous; and that two individuals are sufficient to form a school, suggesting a reaction of individual rather than of mass attraction. Further indication of the stability of schools is provided by the results of Merri-man's (1941) tagging experiments on the striped bass (*Morone saxatilis*). In several instances, two or three fish which had been tagged in a single seine haul were recaptured at the same time and in the same area at some distance from the original point of release.

THE SENSORY BASIS OF SCHOOLING

Vision

The prime physical factor in the formation and maintenance of fish schools is vision. This has been amply demonstrated by Bowen (1931, 1932), Breder (1929, 1942), Breder and Gresser (1941a, b), Breder and Nigrelli (1935), Parr (1927, 1931), Schlaifer (1938, 1939, 1940), Spooner (1931), and others. Parr, in his initial analysis (1927), showed upon both theoretical and experimental grounds that this must be the case. In common with the writers cited above, he was able to demonstrate that when vision is eliminated, by removing or covering the eyes, the schooling reaction ceases immediately. Furthermore, schooling ceases in normal fishes during the hours of darkness, or when the amount of light falls below a certain threshold value.

The formation of a school seems to depend upon the attraction which other fish exert upon the individual. Fish tend to remain parallel to and

at a given distance from their fellows. It is supposed that maintenance of this distance is brought about by a balancing of visual stimuli from each side. Thus, a fish between two others need make no adjustment of distance as long as it perceives its companions with equal intensity. On the other hand, a fish on the extreme outside of a group would be unable to balance its visual stimuli in this way, and would be expected to push constantly toward the center. This would undoubtedly aid in preserving the integrity of the school. Since a certain minimal distance is always maintained between fish, it may be that close approach gives rise to antagonistic stimuli, or somehow weakens the tendency to approach, so that finally a balance is attained.

After observing the behavior of schools of *Jenkinsia*, Breder (1929) concluded that approach was made only to that distance at which an object became clearly visible. Thus, there would be a tendency to maintain a certain "comfortable" retinal effect, which would be reached by close approach to objects of small size and by a more distant approach to larger objects. Unfortunately, there seem to be no published studies of piscine optics, so we do not really know even the theoretical limits of clear vision in fishes.

Spooner (1931), experimenting with *Morone labrax*, produced further evidence of the importance of vision in schooling. He found that fish would school in a typical manner with their own reflections in a glass mirror. This experiment has been repeated, with similar results, by other investigators.

A peculiar manifestation of the schooling phenomenon is the "mill," a circular movement of the individuals within a school, while the school as a whole remains relatively stationary. Both in the natural environment and in aquaria, mills may be formed when a school makes a sharp turn of more than 180°. Parr (1927) explained this by assuming that fish passing each other in opposite directions exert stronger visual stimuli than do their companions travelling in the same direction, since the latter are, with respect to a given individual, nearly stationary. Hence, the fish on the inside of the turn tend to incline toward each other. Their companions on the outside, in order to preserve the visual pattern, follow them, and soon the whole school is circling.

One of the peculiarities of the school, as contrasted with the aggregation, lies in the fact that all its members are oriented in the same direc-

tion. What is the basis of this phenomenon? An examination of the manner in which fishes orient themselves with respect to their environment is in order.

The results of all students indicate that vision is the most important element in orientation, with touch probably ranking second (Lyon, 1905; Dykgraaf, 1933). Fishes possessing sight tend to maintain a constant visual field, while blind individuals remain unoriented unless in contact with a solid object. Other receptor organs, such as the ear canals, lateral line, etc., may function, but are probably of little importance here (Reinhardt, 1935; Breder and Harris, 1936).

In a current, fishes always tend to head upstream. This is obviously a means of conserving energy. Because of the jet-propulsion effect of respiratory movements (Breder, 1926), a resting fish in quiet water tends to move forward, or must "back water" with its paired fins. Facing into a current of appropriate strength obviates the necessity of expending extra energy to remain in one place.

It has been suggested by Breder and Nigrelli (1935) that many, if not all, schools of fishes are of a mechanical rather than a social nature. In other words, fish group together because other fish provide a reference point on which to "take bearings," rather than because of any desire or urge for companionship, etc. In the case of a school formed in a current, the individuals will tend to choose that strength of current in which position can be maintained with least effort. Obviously, some sort of marker must be involved in sustaining such an equilibrium.

It has also been suggested that the same factors operate in pelagic schools, with the difference that the fish themselves produce the current. But in this case it is difficult to see how orientation with respect to current can be involved. It seems much more reasonable to suggest that only the marker or reference point is involved. This is almost certainly true in the "mill."

Under such an interpretation, the apparent expression of social behavior represented by the school can be considered, as is pointed out by Parr (1927), merely as an incidental result of the mechanically integrated reactions of individuals. This point of view allows some hope of an eventual understanding of the phenomenon, but if schooling be considered as a "social instinct," both it and its inhibition become practically impossible of explanation.

Vision as a stimulus can be broken down into several components—color, form, size, movement, etc. The influence of each, either alone or in combination with other components, may be of importance in relation to schooling. In the following sections, consideration will be given to some of the work that has been done on these aspects of vision.

Color Vision

A great deal of investigation was done on this subject during the early 1900's, chiefly through training fishes to respond to variously colored lights or objects. Most of the early work was open to criticism on the grounds of inadequate control of light intensity, for fishes may be quite sensitive to this. For example, Herter (1929) found that several species of fishes could discriminate between gray 13 and gray 14 of Hering's series. Warner (1931) has made an excellent review of the subject.

More recently, Janzen (1933) found that while reactions by goldfish to intensity, as evidenced by tendencies to seek light or darkness, were lost after extirpation of the forebrain, the ability to make associations with colors remained, suggesting that color was not perceived as a function of light intensity. Other work by Bull (1935) and by Brown (1937) supports this conclusion. Using *Blennius pholis*, Bull found that photopic and scotopic conditions did not produce different results, and concluded that the species tested possessed color vision in the ordinary sense of the term. The fact that these fish did not discriminate between intensity values of the same gray color varying between 20 and 20,000 metercandles is evidence that light intensity was not involved in the responses to color.

Brown (1937) found that red was a distinct color for black bass. In discrimination tests, the bass were able to make sharp demarcations of red and yellow from other colors and from a wide series of grays. They were unable to distinguish between red and purple, nor were they successful with green and blue. The latter colors were often confused with each other and with shades of gray. Where discrimination was observed, color seemed to be perceived as a function of wave-length, but in other cases it is apparent that both intensity and wave-length were factors in producing the responses.

A comparison of human color vision with that of the bass, as indicated by these results, suggests that the fish see very much after the manner of a normal human looking through a yellow filter. This is supported by the fact that Brown found a layer of yellow pigment in the eye of the bass.

Some extraordinarily interesting observations have been made by Noble and Curtis (1939) on color perception and its function in the jewel fish. They found that the young of the jewel fish were attracted to red, and suggested that this attraction was related to the breeding colors of the adults. Females were found to recognize their mates as individuals by means of the color pattern on the head of the male. If the whole body of the male, except the head, were painted over, the female still recognized her mate. However, if certain regions of the face were painted, the rest of the body remaining in its natural color, recognition was prevented. It is to be regretted that the investigation did not include an experiment in which the pattern was kept intact but in a different color from the normal. The results of such an experiment would have given much more nearly conclusive proof or disproof of color recognition. As it stands, all that is shown is the ability to recognize a pattern.

Parent jewel fish were found to distinguish their own young from those of other species by the color of the fry, for staining the young fish led to their rejection by their parents. This appears to be a learned reaction, for when a pair of jewel fish, spawning for the first time, was given the young of a related but differently colored species, they cared for these and attacked their own offspring when the latter were placed in the tank. Fish which had spawned normally one or more times always rejected foreign young. An interesting association between the individual or the species and its color is demonstrated here. Whether discrimination is via wave-length or intensity is not clear. However, the rapidity with which the association seems to be made, coupled with the evidence already discussed, suggests that the more constant factor, wave-length, is the one in operation.

That color is not distinguished in all species of fishes, or else is not a factor in their schooling behavior is suggested by the studies of Schlaifer (1942). He found that a painted mackerel was accepted by its fellows, and suggested that movement, rather than color, was the important factor with these fish. This was supported by the observation that mackerel would not attempt to school with a freshly killed individual. However, the subtle changes in shape and color which occur after death should not be ignored as possible influences in such a case.

Color, then, whether it be perceived as a function of wave-length or of intensity of light, may be considered an active influence in the social behavior

of at least some fishes. On the basis of present evidence, this seems to be particularly true of fishes forming aggregations rather than schools. Schlaifer's work with mackerel may indicate either that color has no influence on the behavior of these fish, or that they are color-blind in the truest sense of the word. In the absence of more conclusive evidence, we must reserve judgment on this particular point.

Influence of Form and Size

Differences in form and size have been shown to be factors influencing aggregative behavior in various fishes. Goldsmith (1914) and Maes (1930) showed that fishes could distinguish different sizes and shapes. Herter (1929) trained his fishes to discriminate between different shapes and between different sizes of similar shapes. Rowley (1934) found that goldfish could differentiate between circles whose diameters differed by as little as 0.3 centimeters. It must be recognized, then, that at least some fishes possess a rather high degree of discriminatory ability in regard to size and shape.

Schlaifer (1940) demonstrated a group effect (lowering of the metabolic rate as shown by oxygen consumption, and reduction of locomotor activity) in goldfish associating with a mounted specimen, but found no group effect when a sunfish model was used. This indicates that either the form or the color was concerned, or possibly both. That the group effect could be produced by the influence of a bleached dead goldfish indicates that the response was to form rather than to color. Later experiments with tarpon (Schlaifer, 1941) showed that a greater number of "imitative" respiratory rises could be induced with relatively life-like models than with objects shaped less like another tarpon. Yet, as Schlaifer has pointed out, even his "life-like" model was but a crude thing when compared to a living specimen. It would seem highly possible that the silvery color of this model had a great deal to do with its success over other objects, perhaps because of being a closer approximation to the natural tarpon color, possibly only because of being more easily seen.

Size, as well as form, may have an attracting or repelling influence on fishes. Breder and Halpern (1946) found that fishes of the genus *Brachydanio* were attracted by small targets outside their aquarium, but were repelled by large ones. This could, perhaps, be related to the size of the experimental specimens. If so, it would be expected that the

larger the fish, the larger would be the targets to which they would be attracted or which would repel them. Breder and Coates (1935) observed that male guppies (*Lebistes reticulatus*) would attempt to mate with any retreating object of suitable size.

Further indication of the importance of these factors is given by the fact that schools tend to be made up of individuals of approximately the same size and of the same species (hence, of the same shape). But we can say only that this is so, that these factors have an influence. How they exert their influence is, for the present, a matter of speculation.

Influence of Motion

Schlaifer (1942) noted that normal specimens of the chub mackerel (*Pneumatophorus grex*) would not school with a blind individual. This was apparently due to the slow, atypical manner of swimming of the blind fish, suggesting that the visual stimulus may involve more than just form or color, and may include characteristic motion.

On the other hand, Breder and Gresser (1941a) found that eyed cave fish (*Anoptichthys-Astyanax*) would attempt to school with blind individuals. The eyed animals were unable to keep up with the steady, aimless movements of the blind, leading to "resentment" on the part of the seeing individual and often resulting in its attacking and killing its blind companion. This suggests that the visual stimulus in this case produces an extremely strong reaction, and that atypical movement is not, in these fish, sufficient to inhibit attempts to school. The attack on the blind fish may be considered as a reaction to a deficit (Lashley, 1938).

Tactile Stimuli

Parr (1927) deduced that in catfishes (*Ameiurus* spp.) tactile impressions were chiefly responsible for the schooling activity of the young animals. This was a quite natural deduction, for the young are constantly pushing against each other, and the poor vision and extremely sensitive tactile barbels of these fishes are well known. However, the studies of Bowen (1931, 1932) showed that here again vision is the primary factor, in at least the initial formation of schools. Blinded fish, or those kept in darkness, do not school. On the other hand, it seems quite certain that the mutual pressure produced by individuals pushing toward the center of the group serves to maintain the stability of the school. When the skin of these animals is

anesthetized, their pushing becomes more violent, as though the fish had to push harder to obtain the same degree of tactile stimulation through the now less sensitive skin.

Miss Bowen also found that young catfish would attempt to school with a dead individual held in place with a twig. When a black paraffin model was substituted, the fish would approach the model, play their barbels over it, and turn away. Evidently the visual stimulus initiates the schooling reaction, but tactile stimuli maintain it.

Blinded catfish can detect the presence of nearby companions by means of vibration receptors in the skin, but lacking vision they are unable to remain in contact with an actively moving individual. Dykgraaf (1933) observed a courting response by a blind specimen of *Macropodus viridicatus*, and ascribed it to the reception by the blind animal of vibratory stimuli from the rapidly moving tail of its partner. He found that, in general, the perception of objects by other than visual means rests chiefly in the lateral line organs. This is in direct contrast to Bowen's results and to those of Parker (1905). Breder and Rasquin (1943) observed schooling tendencies in naturally blind and operated characins which could not have been based on visual stimuli. While they did not determine the receptor organs involved, they suggested the possibility of the lateral line, or of chemical sensory receptors.

The "thigmotactic appetite" of young catfish would appear to be a factor ranking next only to vision in maintaining schools. To a lesser extent this is true also of older catfish. The latter, however, seem able to satisfy their thigmotropism by resting in contact with each other. It may be that in the young animals the thigmotropism is the basic cause for schooling, while vision is the chief means by which it is carried on. This is in contrast to the situation in the Scombridae and Clupeidae, described by Parr and by Breder, wherein schooling seems to be based almost entirely upon the visual pattern.

However, thigmotropisms may be functional, to a lesser degree, in other fishes. Breder and Nigrelli (1938) have found that in goldfish, which exhibit no great degree of thigmotropism and are not especially aggregative, the "desire" to be close to a solid object may be of importance. They suggested that the rapid swimming along the sides of a tank by a solitary goldfish may be an expression of a search for companions, and that the approach to

solid objects when in the solitary state is a partial substitute for an approach to companions. In this manner, schooling might be considered as an expression of a thigmotropism.

This phenomenon, if considered as a conscious "desire" to be close to a solid object or companion, at once becomes impossible of further elucidation. Such an interpretation is, therefore, to be avoided. Actions of this sort can be more easily and rationally explained if they are interpreted on a physical basis. Swimming around the sides of a tank could then reduce to an expression of the fact that the environment is sharply limited. That this particular item is not to be analysed so easily is shown by further results of these investigators. Fish placed in a large shallow pan followed a more or less aimless path until they encountered the edge. On a second trial, however, the fish swam in a practically straight path until they reached the edge. Obviously, some sort of thigmotropic reaction is involved, but further analysis of the stimuli involved is necessary before a synthesis of this item of behavior can be made.

If such behavior is considered as a thigmotropism, one can, with equal logic, reverse the premise and interpret the approach to a companion as a substitute for approach to a solid object. In support of this view, it may be pointed out that, in general, schooling is least developed in demersal fishes, which have numerous solid objects readily available in their environment, and most highly developed in pelagic fishes, whose environment characteristically exhibits a dearth of solidity. That fishes such as the clupeids described by Breder (1929) school with each other, rather than with solid objects when the latter are available, may be explained by the assumption that small moving objects exert more intense stimulation than do larger sessile objects.

Chemical Sensitivity

Schooling as part of a "fear" reaction is well known in many species of fishes. This reaction might be simply the result of all the members of a dispersed group fleeing to the safest spot, or to the place best suited for defense, but such an hypothesis is hardly adequate to explain the change from a loose aggregation to a closely-knit, cohesive school. Obviously, under the influence of fear the responses of individuals to each other are altered. Recent work by von Frisch (1938, 1941a, b) and by Göz (1941) indicates that chemical sensitivity may be

involved in this and in other aspects of the schooling phenomenon.

The investigations referred to above showed that a purine- or pterine-like substance (Hüttel, 1941) is released from the skin of the minnow (*Phoxinus laevis*) upon injury, and that the presence of this substance in the water leads to the fear reaction. Since it has also been found that *P. laevis* can discriminate not only between species but also between individuals of the same species upon a chemical sensory basis, it seems quite possible that this is a factor in preserving the unity of a school. It may be suggested that chemical sensitivity would be most important in this respect during darkness, when vision is inoperative.

Influence of the Central Nervous System

Several investigations have been made on the relation of the central nervous system to the social behavior of fishes. Janzen (1933) found that after removal of the forebrain fishes lost "initiative"—the ability to react to external factors. Wiebalck (1937) extirpated the forebrain from *Box salpa* and found that thereafter the operated individuals avoided companions. Noble (1936) found that experimentally produced lesions of the corpus striatum in cichlids resulted in a loss of coordination in breeding behavior. Nearly complete removal of the forebrain inhibited, but did not completely prevent, mating, but such matings were sterile. Sex recognition was not impaired. However, schooling was permanently affected by extirpation of the forebrain. Noble concluded that the forebrain acted to regulate social behavior by coordinating the complex behavior patterns and influencing the pituitary.

EFFECTS OF OTHER ENVIRONMENTAL FACTORS

Many factors of the environment may have pronounced effects on fish aggregations and schools. Breder and Roemhild (1947) described the case of a group of young *Ameiurus nebulosus*, which, when taken from a juvenile school in an outdoor pond and placed in an aquarium, exhibited an almost completely random distribution. While these writers made no report of attempts to analyse the factors producing this startling result, it is mentioned as an indication of the importance of environmental conditions.

Food habits and food supply undoubtedly have a direct bearing on the social behavior of fishes. Langlois (1936a) has reported that cannibalistic

juvenile bass in rearing ponds form separate groups, remaining apart from the normal juvenile schools. In all, eight different types of social organization were noted, all derived from similar origins and seemingly correlated with the size and feeding habits of the individuals composing them.

In general, chemicals do not seem to have any great effect on fish schools. However, Langlois (1936b) reported the formation of peculiar vertical schools of bass when the water of the rearing pond became accidentally chlorinated. Precisely what effect chlorine has is obscure.

Carbon dioxide in high concentrations leads to the formation of schools (Breder and Nigrelli, 1935; Breder and Halpern, 1946). Indeed, Breder and Nigrelli found that schools formed in response to this stimulus would re-form immediately, even after mechanical breaking up, as long as the carbon dioxide tension remained high.

Changes in the physical properties of the water particularly in pH (Noble and Curtis, 1939) and temperature (Breder and Nigrelli, 1935; Breder, 1936; Noble and Curtis, 1939; Breder and Halpern, 1946) are known to produce marked alterations in schooling behavior. Radical changes in pH induce the formation of schools of *Hemichromis*. It may be that the abnormal schools of bass, described by Langlois (1936b), formed in response to a change in pH rather than to direct action of chlorine.

Lowering of temperature results in the formation of schools, both in aquaria and in nature. A number of centrarchids (*Aplites salmoides*, *Lepomis auritus*, *Acantharcus pomotis*, *Pomoxis sparoides*) are known to school under the influence of cold, and probably others do also. In their excellent study on the winter aggregations of the sunfish (*Lepomis auritus*), Breder and Nigrelli (1935) noted that schooling occurred at 5°C., but that, on raising the temperature, the school did not break up until a temperature of 10°C. had been reached. They suggested that this lag was due to "psychic inertia." It seems much more logical to interpret this as indicative of a physiological, rather than a "psychic," threshold. Indeed, all the evidence suggests strongly that there is a close connection between schooling and metabolic rate. Studies of the physiology of fishes would doubtless go far toward disclosing the nature of this relationship. At present, we can say only that decreasing or impeding the normal rate of metabolism seems to be correlated with the formation of schools. Why this should be so is not at all clear. Langlois

(1936b) suggested that "stimulating body contacts cause the opposite reaction and tend to prevent the ultimate loss of life from cold." Before we can accept this suggestion, however, it is necessary to inquire into the nature of the stimulations and reactions produced by "stimulating body contacts."

SOME PHYSIOLOGICAL CONSEQUENCES OF SCHOOLING

It has long been known that animals in groups may exhibit certain physiological differences from solitary individuals. A great deal of work has been done in this field, of which only a few examples will be considered here. Allee (1934) has reviewed the subject.

Schuett (1933, 1934) was one of the first to demonstrate the presence of group effect in fishes, finding that fishes in groups were less active or had lower metabolic rates, as evidenced by oxygen consumption, than solitary animals. These results were confirmed by Schlaifer (1938, 1939), who also reinforced Schuett's suggestion that the relation between the number of fish and the volume of water in which they were contained could have an effect upon the activity of the fish. This is a factor which seems to have been inadequately controlled in studies of this sort.

The work of Escobar, Minahan, and Shaw (1936) also demonstrated the presence of group effect in homotypic (all individuals of the same species) groups. A possible explanation lies in their suggestion that, in groups, the "free path" movement of an individual is obstructed by its companions. Continuous small movements are made, adjusting direction and orientation in relation to nearby companions. By contrast, an isolated fish maintains more prolonged single movements, resulting in greater total activity.

If this is indeed the case, it should be possible to produce group effect with a solitary fish in a complicated maze, one so complex that long single movements would be impossible. But even if this experiment should yield the expected results, it would not explain the observations by Escobar, Minahan, and Shaw (1936), by Schlaifer (1940), and by Schlaifer and Breder (1940) that group effect is not present in heterotypic groups. In some cases, this result might be laid to greater activity on the part of the individuals of the second species, for motion in itself seems to be a stimulus to activity; but in other cases this interpretation cannot be made.

The question of the group effect is filled with apparent contradictions. The evidence presented in this section suggests that aggregation causes a lowering of the metabolic rate. The evidence discussed in the previous section tends to show rather the opposite relation. At the moment we have no means of reconciling these two antagonisms. Visual perception of companions appears to be a factor in producing a group effect (Schlaifer, 1938, 1939), yet Breder and Rasquin (1943) and Schlagel and Breder (1947) found a group effect in blind characins. An adequate analysis of the factors involved is still lacking. Until it is procured, a comprehensive explanation of the phenomenon cannot be made. The manner of perception of companions and the volumetric relationships involved will particularly bear more detailed study.

INFLUENCE OF SEXUAL ACTIVITY

The effect of sex upon schooling is often marked, and the relationships between the tendencies toward sexual behavior and toward schooling behavior are complex. That the young of many species exhibit schooling behavior is well known. This is true, for example, of the Cichlidae and Centrarchidae, wherein not only do the young tend, of themselves, to school, but this impulse is reinforced by parental "herding." That this is indeed the case, rather than that herding by the parents brings about schooling in the young, is indicated by the observations of Noble and Curtis (1939) on *Hemichromis bimaculatus*, to the effect that the young of this species tend to bunch up, although they form more compact groups under the influence of parental guiding. Juvenile schools of various centrarchid fishes have probably been seen by nearly everyone who has wandered along a stream in warm weather. Breder and Halpern (1946) studied aggregating behavior in young *Brachydanio rerio*. These fish are not particularly aggregative until several months old. Breder and Halpern isolated fertilized eggs and raised the young in isolation to an age of several months. On being placed in a tank with a school of young of comparable age, these fish immediately joined the school, indicating the unlearned nature of the reaction. Parr (1931) suggested that the early appearance of the schooling reaction in the life of the individual, and the fairly constant relationships of schooling to systematic groups of fishes, indicate a phylogenetic rather than an ontogenetic origin of the phenomenon.

Young specimens of *Aequidans latifrons* cease their juvenile schooling with the appearance of the adult colors (Breder, 1934). Since this is correlated with the development of the gonads, Breder suggested that a gonadal influence effected the inhibition of schooling. But this need not be interpreted as a direct influence. It is quite possible that pituitary action, itself influenced by the gonads or by visual stimulation from the secondary sex characters, could accomplish the same thing. This would be related only indirectly to gonadal influence. Bowen (1931) and Breder and Roemhild (1947) noted the gradual inhibition of schooling with maturity in young catfish. The latter writers also reported that "sex-starved" guppies showed distinct pairing of males with females, while those not in such a sad condition tended to pair as two males together and two females together. This observation was made on a group of only four fishes. It would be interesting to make similar experiments with larger groups.

Among certain centrarchid fishes a heterosexual, centrifugal influence breaks up the wintering aggregation (Breder, 1936). This becomes stronger as the males move into shallow water, resulting in territoriality. The choice of nesting sites is controlled by three factors: the centrifugal influence among the males, the space available, and the depth of the water. Post-spawning aggregations sometimes occur, but these are never strong until the approach of cold weather.

Parr (1931) has analysed the relationships between sex and schooling. Assuming that non-schooling is the more primitive condition, he states that the sex complex is undoubtedly important in this connection, having its basis, like the school, in the visual perception of other individuals. Further, differential sex attraction tends to break up the uniformity of the school. There will be weak attraction, or even repulsion, among members of the same sex, and a correspondingly stronger attraction among members of opposite sexes. However, to obtain such differential attraction, there must exist some sort of sexual dimorphism. Furthermore, mechanisms of sexual attraction cannot be lost, unless replaced by schooling behavior, without leading to the extermination of the species. Thus, in forms which survive, this mechanism must change from a heterosexual to an ambisexual orientation, resulting in attraction of all individuals of a species for each other, regardless of sex. In this manner, the sex complex may develop into the

schooling complex. In general, schooling is not accompanied by conspicuous sexual differences. The Clupeidae and Scombridae, exhibiting the most perfect of schools, show complete lack of external sex differences and spawn in indiscriminate schools, without apparent heterosexual orientation. The monomorphous Haemulidae are a schooling group, but the dimorphous Labridae and Scaridae are not. Among dimorphous fishes, schooling is often common in the young until such time as the animals become sexually mature. The stickleback (*Gasterosteus aculeatus*) normally schools, but with the appearance of dimorphous sex characters in the breeding season the schools disintegrate, only to re-form following the cessation of breeding.

It will be noted that Parr's argument can be carried equally well from the standpoint taken by him (that schooling replaces sexual dimorphism) or from the opposite assumption, that sexual dimorphism replaces schooling. In either case, it develops that one possible function of the school is the insurance of successful reproduction. The widespread habit of schooling during periods of sexual inactivity suggests that the aggregating impulse is of wide distribution among various groups of fishes, while actual schooling depends upon the promoting or suppressing influence of externally perceptible sex differentiation.

FUNCTIONAL ASPECTS OF SCHOOLING

Thus far, some of the factors operating to bring about or to prevent schooling, and some of the results of the phenomenon have been discussed. In this section, note will be taken of some possible functions of the school.

Parr's (1931) theory of the importance of schooling in insuring successful reproduction has already been discussed. Bowen (1931) suggested that the juvenile schools of catfish might be a protective phenomenon. These fish are notoriously poor of eyesight, and it seemed possible to Miss Bowen that the many eyes of the group might compensate for the poor vision of the individuals composing it. If it could be demonstrated that the "fear substance" found by von Frisch in the skin of minnows is released upon visual perception of a fear stimulus, this interpretation of Miss Bowen's would not be as far-fetched as it sounds. In such a case, visual perception of a fear stimulus (e.g., a predator) by one member of the school would lead to release of the "fear substance" and so to flight of the whole school. But even such an interpreta-

tion as this is of doubtful validity, since von Frisch has stated that the "fear substance" requires thirty seconds or more to produce an effect. A time interval of this length would be more than sufficient for any self-respecting predator to wreak considerable damage on a school of small fish.

Allee and Bowen (1932) found that groups of fish were able to neutralize greater amounts of a toxic substance (colloidal silver) in their environment than were single fish in the same volume. This was shown to be a direct mass relationship, since in proportionate volumes there was no significant difference between groups and isolates in the amount of silver removed per fish. Allee and Bowen suggested that the major advantage of the group over the individual in such a situation lay in the greater removal of toxic substance per unit time by the group. Slime and excretory products were found to be the active agents.

Langlois (1936a) described the feeding behavior of young black bass at the time when they begin to take food in large particles. At this time the young fish strike the food particle, grasp it, and swim off with it, away from the rest of the school. This presents a marked contrast to their early behavior when feeding on zooplankton. Then the young fish approach a food particle and engulf it, or suck it into the mouth, but do not exhibit the "grab and retreat" pattern of behavior. It is possible that the later type of behavior might be developed as a corollary to competition provided by the group, and as such might well be expected to have a positive survival value.

It has often been suggested that animals in groups learn more rapidly than when alone. The possible influence of a "trained" animal over an "untrained" one almost invariably leads to the question of imitation. Do animals learn more rapidly when associating with a "trained" individual, or do they not? If so, do they learn through imitating? Little is known about the answers to these questions as far as fishes are concerned. Welty (1934) seems to have been the only person to experiment with fishes in this way.

He believed that fishes in groups learn more rapidly than when alone, and also that fishes learn even more rapidly when associated with a fish already trained than when in untrained groups. Group-trained fishes seem to retain their training a little better than those trained singly. Welty felt that imitation is a strong factor in group learning. If such be the case, the survival value of

imitation would depend upon the survival value of the pattern imitated. However, as he pointed out, the survival value of the behavior pattern of a surviving, successful species would, of necessity, be high. Welty suggested that the chief value of such imitation would lie in learning parts of the pattern which were not "instinctive." One might wonder just how much of the behavior pattern of fishes is innate and how much is learned, and also how much of the latter portion can be learned by imitation.

It should not be difficult to devise experiments to test for imitative behavior. For example, in a schooling species, if one fish learns a maze, will another one follow the first without error and thereafter perform correctly when alone? A positive answer would suggest the presence of imitative ability. Welty's experiments allowed goldfish to observe a trained fish pass through a hole in a partition and be fed. The curves of results by the visually conditioned fish showed a shorter time, up to about the fifth trial, required for the fish to pass through the hole. However, the shape of the curves is that of typical "trial-and-error learning curves," which would not be expected if imitation were actually in operation. Furthermore, analysis of Welty's data as read from his graphs (no tables were published) shows that the differences in time required by conditioned and unconditioned fish are definitely not significant. We cannot, therefore, accept these results as evidence of imitation, nor can we agree with Breder and Nigrelli (1938) that these results "give a measure of the influence of an individual that 'knows' where it is going over one that does not."

Breder (1934) suggested that the negative phototropism of schools of young *Aequidons latifrons* had a definite survival value in the wild state. Such behavior would lead the young to frequent dark holes on the stream bottoms, where, presumably, they would be less visible and less liable to the attacks of predators. Breder also noticed that, among adults of this species, a high concentration of carbon dioxide led to the formation of stable schools, although at low carbon dioxide levels the adults exhibited rather strong anti-social tendencies. He attempted to ascribe a positive survival value to this behavior in nature, where tropical pools often become dry. Presumably, as the pool dries up and becomes smaller, the carbon dioxide content of the water will rise, causing schooling behavior to dominate anti-social fight-

ing and enabling the group to live harmoniously in a restricted space. It might also be that schooling would produce a group effect, with lowered oxygen consumption. Still, this seems a tenuous argument, for even though these effects were present in each individual, the concentration of individuals might be expected to result in an increase in total metabolism per unit volume within which the fish were concentrated, and hence a more rapid depletion of the available oxygen and more rapid suffocation of the individuals occupying the space. In considering the possible value of schooling under abnormal conditions, it is well to recall the statement of Breder and Nigrelli (1935) that such schools or aggregations may be useful, neutral, or even harmful to the individual or to the species, or to both.

CONCLUSION

The premise of visual reference points proposed by Breder and Nigrelli (1935) is probably the true explanation of the most basic factor in the formation of schools. But when we consider, for example, the species-specific schools of certain pelagic fishes, or the apparent "preferences" of various species for particular shapes, colors, types of movement, etc., it becomes obvious that our knowledge of the stimuli producing the schooling response is inadequate. The same is true of such phenomena

as group effect. More factors are involved than a simple reference point by which a fish can hold its position. Adequate analyses of the stimuli and of their actions are needed, for as yet we are but poorly aware of the influences affecting these phenomena.

It is quite possible that further studies of the relationships between endocrine activity and behavioral phenomena will lead to an adequate explanation of some of these observations. The mathematical approach to the problem of distribution in space taken by Breder and his co-workers seems a promising line of attack and should lead to useful general propositions. But it must always be recognized that many factors influence the schooling reaction and that these factors may, and undoubtedly do, act in different ways in different species of fishes. "Instincts," "tropisms," and "desires" as causal factors can lead but to blank walls. Only well controlled investigations, aimed at the mechanisms involved and accompanied by careful integration of the results, can ever hope to reach an adequate solution of the problem.

ACKNOWLEDGMENT

I wish to thank Prof. Frank Beach, who suggested the writing of this review, for his sympathetic aid in its preparation, and Profs. Daniel Merri-man and Yngve H. Olsen for their kind criticisms.

LIST OF LITERATURE

- ALLEE, W. C. 1934. Recent studies in mass physiology. *Biol. Rev.*, 9: 1-48.
- , and EDITH S. BOWEN. 1932. Studies in animal aggregations. Mass protection against colloidal silver among goldfishes. *J. exp. Zool.*, 61: 185-207.
- BOWEN, EDITH S. 1931. The role of the sense organs in aggregations of *Ameiurus melas*. *Ecol. Monogr.*, 1: 1-35.
- . 1932. Further studies of the aggregating behavior of *Ameiurus melas*. *Biol. Bull. Wood's Hole*, 63: 258-270.
- BREDER, C. M., JR. 1926. The locomotion of fishes. *Zoologica, N. Y.*, 4: 159-297.
- . 1929. Certain effects in the habits of schooling fishes, as based on the observation of *Jenkinsia*. *Amer. Mus. Novit.*, 382: 1-5.
- . 1934. An experimental study of the reproductive habits and life history of the cichlid fish, *Aequidans latifrons* (Steindachner). *Zoologica, N. Y.*, 18: 1-42.
- . 1936. The reproductive habits of the north American sunfishes (Family Centrarchidae). *Zoologica, N. Y.*, 21: 1-48.
- . 1942. Social and respiratory behavior of large tarpon. *Zoologica, N. Y.*, 27: 1-4.
- , and C. W. COATES. 1935. Sex recognition in the guppy, *Lebistes reticulatus*. *Zoologica, N. Y.*, 19: 187-207.
- , and E. B. GRESSER. 1941a. Correlation between structural eye defects and behavior in the Mexican blind characin. *Zoologica, N. Y.*, 26: 123-131.
- , and —. 1941b. Further studies on the light sensitivity and behavior of the Mexican blind characin. *Zoologica, N. Y.*, 26: 289-296.
- , and FLORENCE HALPERN. 1946. Innate and acquired behavior affecting the aggregation of fishes. *Physiol. Zool.*, 19: 154-189.
- , and J. E. HARRIS. 1936. Effect of light on orientation and stability of young plectognath fish. *Pap. Tortugas Lab.*, 29: 25-36.
- , and R. F. NIGRELLI. 1935. The influence of temperature and other factors on the winter aggregations of the sunfish, *Lepomis auritus*, with critical remarks on the social behavior of fishes. *Ecology*, 16: 33-47.

- BREDER, C. M., JR. and R. F. NIGRELLI. 1938. The significance of differential locomotor activity as an index to the mass physiology of fishes. *Zoologica*, N. Y., 23: 1-29.
- , and PRISCILLA RASQUIN. 1943. Chemical sensory reactions in the Mexican blind characins. *Zoologica*, N. Y., 28: 169-200.
- , and JANET ROEMHILD. 1947. Comparative behavior of various fishes under differing conditions of aggregation. *Copeia*, 1947 (1): 29-40.
- BROWN, F. A., JR. 1937. Responses of the large-mouth black bass to colors. *Bull. Ill. nat. Hist. Surv.*, 21: 33-55.
- BULL, H. O. 1935. Studies on conditioned responses in fishes. Part III. Wave-length discrimination in *Blennius pholis* L. *J. Mar. biol. Assoc. U. K.*, n.s., 20: 347-364.
- DYKGRAAF, S. 1933. Untersuchungen über die Funktion der Seitenorgane an Fischen. *Z. vergl. Physiol.*, 20: 162-214.
- ESCOBAR, R. A., R. P. MINAHAN, and R. J. SHAW. 1936. Motility factors in mass physiology: Locomotor activity of fishes under conditions of isolation, homotypic grouping, and heterotypic grouping. *Physiol. Zool.*, 9: 66-78.
- GOLDSMITH, MARIE. 1914. Les réactions physiologiques et psychiques des poissons. *Bull. Inst. gén. Psychol.*, 14: 97-228.
- GÖZ, H. 1941. Über den Art- und Individualgeruch bei Fischen. *Z. vergl. Physiol.*, 29: 1-45.
- HERTER, K. 1929. Dressurversuche an Fischen. *Z. vergl. Physiol.*, 10: 688-711.
- HÜTTEL, R. 1941. Die chemische Untersuchung des Schreckstoffes aus Elritzenhaut. *Naturwissenschaften*, 29: 333-334.
- JANZEN, W. 1933. Untersuchungen über Grosshirnfunktionen des Goldfisches (*Carassius auratus*). *Zool. Jb., (Abt. allg. Zool. Physiol.)*, 52: 591-628.
- LANGLOIS, T. H. 1936a. A study of the small-mouth bass, *Micropterus dolomieu* (Lacepede) in rearing ponds in Ohio. *Bull. Ohio biol. Surv.*, 6 (33): 191-225.
- . 1936b. Survival value of aggregational behavior of bass under adverse conditions. *Ecology*, 17: 177-178.
- LASHLEY, K. S. 1938. Experimental analysis of instinctive behavior. *Psychol. Rev.*, 45: 445-471.
- LYON, E. P. 1905. On rheotropism. I. Rheotropism in fishes. *Amer. J. Physiol.*, (1904), 12: 149-161.
- MAES, R. 1930. La vision des formes chez les poissons. *Ann. Soc. zool. Belg.*, (1929), 60: 103-129.
- MERRIMAN, D. 1941. Studies on the striped bass (*Roccus saxatilis*) of the Atlantic coast. *Fish. Bull. Fish Wildlife Serv.*, 50 (Fish. Bull. 35): 1-77.
- NEWMAN, E. 1876. Mr. Saville Kent's lecture, at the Society of Arts, on "The aquarium: construction and management." *Zoologist*, ser. II, 11: 4853-4858.
- NOBLE, G. K. 1936. The function of the corpus striatum in the social behavior of fishes. *Anat. Rec.*, 64: (supp. 3) 34: abst. 76.
- , and B. CURTIS. 1939. The social behavior of the jewel fish, *Hemichromis bimaculatus* Gill. *Bull. Amer. Mus. nat. Hist.*, 76: 1-46.
- PARKER, G. H. 1905. The function of the lateral line organs in fishes. *Bull. U. S. Bur. Fish.*, (1904), 24: 183-207.
- PARR, A. E. 1927. A contribution to the theoretical analysis of the schooling behavior of fishes. *Occ. Pap. Bingham oceanogr. Coll.*, 1: 1-32.
- . 1931. Sex dimorphism and schooling behavior among fishes. *Amer. Nat.*, 65: 173-180.
- . 1937. On self-recognition and social reaction in relation to biomechanics, with a note on terminology. *Ecology*, 18: 321-323.
- REINHARDT, F. 1935. Über Richtungswahrnehmung bei Fischen, besonders bei der Elritze (*Phoxinus phoxinus* L.) und beim Zwergwels (*Amiurus nebulosus* Raf.). *Z. vergl. Physiol.*, 22: 570-613.
- ROWLEY, JEAN B. 1934. Discrimination limens of pattern and size in the goldfish *Carassius auratus*. *Genet. Psychol. Monogr.*, 15: 245-302.
- SCHLAGEL, SYLVIA R., and C. M. BREDER, JR. 1947. A study of the oxygen consumption of blind and eyed cave characins in light and in darkness. *Zoologica*, N. Y., 32: 17-27.
- SCHLAIFER, A. 1938. Studies in mass physiology: Effect of numbers upon the oxygen consumption and locomotor activity of *Carassius auratus*. *Physiol. Zool.*, 11: 408-424.
- . 1939. An analysis of the effect of numbers upon the oxygen consumption of *Carassius auratus*. *Physiol. Zool.*, 12: 381-392.
- . 1940. The locomotor activity of the goldfish, *Carassius auratus* L., under various conditions of homotypic and heterotypic grouping. *Ecology*, 21: 488-500.
- . 1941. Additional social and physiological aspects of respiratory behavior in small tarpon. *Zoologica*, N. Y., 26: 55-60.
- . 1942. The schooling behavior of mackerel: A preliminary experimental analysis. *Zoologica*, N. Y., 27: 75-80.
- , and C. M. BREDER, JR. 1940. Social and respiratory behavior of small tarpon. *Zoologica*, N. Y., 25: 493-512.
- SCHUETT, F. 1933. Studies in mass physiology: The effect of numbers upon the oxygen consumption of fishes. *Ecology*, 14: 106-122.
- . 1934. Studies in mass physiology: The activity of goldfishes under different conditions of aggregation. *Ecology*, 15: 258-262.

- SPOONER, G. M. 1931. Some observations on schooling in fish. *J. Mar. biol. Assoc. U. K.*, n.s., 17: 421-448.
- VON FRISCH, K. 1938. Zur Physiologie des Fisch-Schwarmes. *Naturwissenschaften*, 26: 601-606.
- . 1941a. Die bedeutung des Geruchsinnes im Leben der Fische. *Naturwissenschaften*, 29: 321-333.
- . 1941b. Über eine Schreckstoff der Fischhaut und seine biologische Bedeutung. *Z. vergl. Physiol.*, 29: 46-145.
- WARNER, L. H. 1931. The problem of color vision in fishes. *Quart. Rev. Biol.*, 6: 329-348.
- WELTY, J. C. 1934. Experiments in group behavior of fishes. *Physiol. Zool.*, 7: 85-128.
- WIEBALCK, U. 1937. Untersuchungen zur Funktion des Vorderhirns bei Knochenfischen. *Zool. Anz.*, 117: 325-329.



NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Assistant Editor of THE QUARTERLY REVIEW OF BIOLOGY, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.

SEXUAL BEHAVIOR IN THE HUMAN MALE, WHITE, U. S. A.

A review of *Sexual Behavior in the Human Male*, by Alfred C. Kinsey, Wardell B. Pomeroy, and Clyde E. Martin, of Indiana University. Published by W. B. Saunders Company, Philadelphia & London. \$6.50. xvi + 804 pp.; graphs and figures. 1948.

By Bentley Glass, The Johns Hopkins University

Great scientific books are of two chief sorts. The more frequent kind is that which surveys an active field of science, summarizes the work of perhaps hundreds of scientific lives, and with masterly grasp achieves a synthesis of scattered and ill assimilated materials. Such were Wilson's *The Cell* and Bayliss' *General Physiology*, and, in more recent years, Dobzhansky's *Genetics and the Origin of Species*.

But once in a great while a book comes along which marks the commencement, not the climax or end, of a scientific era. These are the books that virtually begin a new science, that blaze a trail into the unknown. Such a book is *Sexual Behavior in the Human Male*. Heretofore our knowledge of human sexual behavior has been gleaned casually, from chance communicants and from patients with neuroses and sexual problems of one sort or another. As the authors point out, "there are, of course, thousands of individual case histories... in the writings of Havelock Ellis, Freud, Stekel, Hirschfeld... and a long list of others. In many ways these have been important contributions on sex... But none of the authors of the older studies, in spite of their keen insight into the meanings of certain things, ever had any precise or even an approximate knowledge of what average people do sexually... They never knew what things were common and what were rare, because their data came from the miscellaneous and usually unrepresentative persons who came to their clinics (Freud, Hirschfeld, et al.), or from persons from whom they happened to

receive correspondence (Ellis), or from limited numbers of persons whom they interviewed in elaborate detail (as in the Henry study)." The authors reiterate that a clinic is the very last place to choose to learn about normal sex behavior, for only the maladjusted are to be found there. There have been, of course, a variety of statistical studies prior to this one, but none of enough scope to be reliable. Kinsey and his colleagues have found that "about 300 cases are desirable for a sample in a group that is homogeneous for sex, age, educational level, and the various other factors... Only five of the studies [previously published] were restricted to populations which were homogeneous for three or more of the factors listed above."

To what extent, then, and in what ways has the work of this group succeeded where previous efforts failed. First of all, in the scope of the project, which far exceeds that of any earlier work. Kinsey, a student of variation in gall-wasps, began with the recognition that only a study of large series of individuals and of adequate samples of groups could possibly lead to reliable conclusions. Only the funds generously provided by the Rockefeller Foundation have made so extensive a study possible. 12,000 histories, laboriously gathered in the course of nine years, have been drawn from every state in the Union (but principally from the northeastern quarter of the country), from people aged 5 to 90 years, and from every stratum of American society—rural and urban; the levels of grade school education, high school, college, and post-graduate training; laborers, inmates of penal institutions, members of the underworld, prostitutes, clerks, farmers, business men, college students and professors, clergymen, etc. In the present volume, the 5,300 white males of the sample are analysed. Approximately one-half of these are college-bred, so that one may readily see that no effort was made to sample all strata of the population equally. The Negro

males have not furnished a large enough sample for analysis at the present time.

The real heart of the study is to be found in a sequence of chapters (2-4) that most readers will probably skip. These chapters deal with Interviewing, with the Statistical Problems, and with the Validity of the Data. These are vital because the success of such a study inheres in the nature of the methods that were used. Modern sampling techniques were chosen: approximately equal samples, up to a size of 300, were sought from each of the ultimate groups, in order to minimize sampling errors, and the total U. S. population was then reconstructed by multiplying each group by its respective proportion of the entire population. Attention was given to the proper diversification of each sample. Samples where one hundred per cent of the group submitted histories were sought and compared with partial samples of similar groups, the results being found to check closely.

In gathering the data, the use of questionnaires was discarded as unreliable, and all data were secured by personal interviews by one or another of the three trained investigators. Strict confidence regarding the identity of histories has been maintained by almost fantastic precautions of coding and safekeeping. A basic minimum of about 300 items was systematically covered in each history-taking. Rapid, direct questions helped to lessen lying or subterfuge, but getting the confidence of the subject was equally important. Such comments may convey a minimal idea of the procedure, but the chapter will have to be read in its entirety to be appreciated. It was no overstatement the authors made in remarking that "the development of an interviewer is a long and slow process... a full year of training..."

Everything hinges upon the Validity of the Data in such a study as this. Can the conclusions be believed? It would be better never to read them if the data on which they are based are false. One point must therefore never be forgotten, in the present instance. The data here are not actually items of sexual behavior—the data themselves are the reported histories of sexual activities. The real behavior is only to be seen through the glass of memory, beclouded by conscious and subconscious motives for concealment and falsification. But lying can be detected by questions that cross-check one another. Falsification can be detected by checking the independently taken histories of husbands and wives, etc. The constancy of memory can be validated by re-takes of histories after a lapse of 18 months or more. The results obtained by one interviewer can be compared with those obtained by another on a similar group. In all these respects the data show remarkable consistency and reveal a high order of validity. The conclusion one is entitled to make, therefore, is that the histories of sexual behavior are statistically reliable data. As histories, they represent probably a minimum rather than a maximum

relation to the real behavior, for the fading of memory and the predominance of motives for concealment over those for exaggeration would both work to reduce reported sexual activities below the real.

The data are analysed to throw light on early sexual development; on the total sexual outlet, comprising (1) coitus,—premarital, marital, and extramarital, (2) masturbation, (3) nocturnal emissions, (4) heterosexual petting, (5) homosexual relations, and (6) animal contacts; on intercourse with prostitutes and female companions; on the relation to sexual outlet of age, marital status, age of adolescence, social level, rural-urban background, and religious background; and on the stability of sexual patterns. Some of the major findings and conclusions may be briefly summarized:

- (1) Pre-adolescent sex play, more homosexual than heterosexual, rises to an incidence of 38.8 per cent at age 12.
- (2) Orgasm has been observed in boys of every age from 5 months to adolescence.
- (3) Sexual capacity, as measured by speed in reaching orgasm and capacity for multiple orgasms, is highest in pre-adolescent years and declines steadily (logarithmically) throughout life.
- (4) Enormous individual variation in total sexual outlet occurs, e.g., frequencies range from 0 to 29+ times per week.
- (5) The peak of actual performance (total outlet) is highest in the middle to late teens (single males: mean frequency 3.3 per wk.; married males, 4.8). It has dropped 50 per cent by age 50.
- (6) The majority of males, up to age 50, utilize 2 or more of the 6 sources of outlet. From age 16 to age 25, about 90 per cent utilize 2 or more sources.
- (7) The accumulative incidence of impotence is 6.7 per cent of males at 50 years of age, 20 per cent at age 60, 75 per cent at age 80.
- (8) The males who enter adolescence earliest have statistically the longest and most active sex lives.
- (9) Marital status tends to increase total outlet, while reducing but not eliminating outlets other than marital intercourse.
- (10) Sexual patterns of behavior vary markedly for different social-educational strata.
- (11) Masturbation is at least twice as frequent in the highest educational and occupational classes as in the lowest. The accumulative incidence of those who ever masturbate at any time is close to 90 per cent in all classes.
- (12) Nocturnal emissions are three to four times as frequent in single males of the highest educational and occupational classes as in those of the lowest. The accumulative incidence for the total U. S. population reaches a maximum of 83 per cent at age 29, but is only 76 per cent in those of educational level 0-8 (yrs.), and is virtually 100 per cent in those of educational level 13+.

- (13) The same general relation holds for heterosexual petting to climax, but the accumulative incidence is lower (16.5 per cent compared with 60 per cent).
- (14) The accumulative incidence of pre-marital intercourse in the total population reaches 90 per cent. The incidence is higher for the lowest educational level (98%) than for the highest level (66%); and the frequency may be seven times as great. The incidence is lower for rural males than for urban.
- (15) "Not more than 62 per cent of the upper level male's outlet is derived from marital intercourse by the age of 55."
- (16) Coital techniques and the incidence of nudity in coitus vary markedly in different social strata. Variety of techniques and a high frequency of nudity characterize the upper educational level.
- (17) "Mouth-genital contacts . . . occur at some time in the histories of nearly 60 per cent of all males." They are much commoner at high school and college levels than in those of grade school education only.
- (18) About one-half of all white males engage at some time in extra-marital intercourse. It is highest in those of grade school educational level, but the incidence decreases with advancing age.
- (19) Post-marital sexual activity, although less than the degree of marital activity, tends to resemble it far more than that of single men.
- (20) The accumulative incidence for intercourse with prostitutes reaches a total of two-thirds of the male population, but it is very much lower (ca. one-third) in the college-bred group.
- (21) Homosexual outlets reach an accumulative incidence of 37 per cent of all males. The incidence is higher for single males (50%), and is highest at the high school educational level. At any one time 22.9 per cent of males are calculated to be homosexual to some degree, 6.2 per cent exclusively homosexual. Homosexuality declines with age.
- (22) Animal contacts are almost wholly limited to rural males. The accumulative incidence in the single rural population is about 17 per cent. It is highest in the college-bred group (29%).
- (23) Social patterns of sexual behavior begin to appear in very early childhood. Children are the chief agents for the transmission of the sexual mores. "Exceedingly few males modify their attitudes on sex or change their patterns of overt behavior in any fundamental way after their middle teens."

The many graphs and diagrams in the book help to make these and numerous other significant relations clear. The reader who patiently plows through these masses of statistics and figures can come at the end to but one conclusion. Here is a study of heroic magnitude, carefully planned, patiently amassed, cautiously

evaluated. It carries an overwhelming conviction of the honesty and reliability of its conclusions.

In the end, a number of matters stand out sharply in an altogether new light. In sexual behavior man is a characteristic mammal, and many acts banned by our traditional mores and widely regarded as "abnormal sex behavior" or "perversions" are known to be common in mammals. Kinsey's study shows that these forms of sex behavior are neither rare nor suppressed in man. Some of them are common; a number are well-nigh universal. With this revelation, the enormous discrepancy between our Judaeo-Christian mores and our legislation regarding sex behavior, on the one hand, and our actual behavior and moral attitudes, on the other, is inescapable. One of the first-fruits of this knowledge should be, as the authors maintain, a thoroughgoing examination and revision of our legislation on sexual matters. How wickedly unjust to sentence for many years a few unfortunate men by chance caught in the act, or reported by malicious persons to the police for an act, that a quarter or a half of all their fellows engage in with impunity. Penalties for sexual behavior must be placed on exactly the same footing as any other kind of illegal behavior, namely on the existence of demonstrable physical or psychological injury to another person.

But man is also a cultural animal, and this too is profoundly reflected in his sexual behavior. It is most significant to recognize that the patterns of *current* and *accepted* behavior are vastly different in different educational and social strata, even within a nation of so notoriously homogeneous a culture and so exaggerated a craving for uniformity as the United States of America. It is important to know that these patterns are virtually life-long in the individual; that they are established early in childhood and are largely transmitted through children; that religious beliefs are ineffective in suppressing or sublimating sex activities and are mainly capable only of diverting it from one outlet to another. And what must be the psychological consequences of so widespread a violation of moral taboos? The enormous individual differences in the frequency of sexual outlet among normal individuals, and the almost complete shift from pre-marital intercourse as the chief sex outlet for single males of one stratum to masturbation, in another stratum, have scarcely been suspected. With more justice than it ever had when applied to the economic conditions of living, we may now say: The one half doesn't know how the other half lives.

Freud was evidently right regarding the existence of an early sex life in children. On the other hand, it is now clear that much of the "aberrant sex behavior" he attributed to maladjustment arising in childhood is not aberrant sex behavior at all but a common type of sex behavior characteristic of a large proportion of well adjusted males. Homosexuality, for example,

may now be characterized as virtually an arrest of sex behavior at a pre-adolescent or early adolescent stage. The findings of this study cannot fail to effect a near-revolution in psychiatry and psychoanalysis, while at the same time providing these fields with a firmer base for the future.

This is only the first volume in a projected series of nine that will, over a period of 20 years, report on all phases of the 100,000 histories to be ultimately

sought. In the present volume, some of the preliminary findings about white females are mentioned. The next volume in the series will consider that segment of the population in detail. Other volumes will cover such subjects as sex factors in marital adjustment, legal aspects of sex, heterosexual-homosexual balance, prostitution, sex education, etc. The entire series will represent a monumental achievement of the application of the methods of modern taxonomy to human biology.

REVIEWS AND BRIEF NOTICES

General Biology: Philosophy and Education.....	42
Biology: History and Biography.....	45
Ecology and Natural History.....	47
Evolution.....	48
Genetics and Cytology.....	52
General and Systematic Botany.....	53
Economic Botany.....	58
General and Systematic Zoology.....	59
Economic Zoology.....	63
Animal Morphology.....	64
Animal Growth and Development.....	67

Animal Physiology.....	68
Animal Nutrition.....	71
Biochemistry.....	72
Microbiology.....	76
Parasitology.....	76
Health and Disease.....	77
Psychology and Animal Behavior.....	85
Human Biology.....	94
Biometry.....	101
De Omnibus Rebus et Quibusdam Aliis.....	103

GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

THE LIVING THOUGHTS OF DESCARTES. *The Living Thoughts Library.*

Presented by Paul Valéry. David McKay Company, Philadelphia. \$2.00. vi + 160 pp. + 1 plate. 1947.

Only recently (cf. Q.R.B. 22: 59. 1947) it was remarked that English editions of Descartes' *Discourse on the Method of Rightly Conducting the Reason* were almost unprocurable. That sad condition is now remedied by the appearance of a volume in the neat, pocket-sized Living Thoughts Library containing a penetrating introductory essay by Paul Valéry, and, in addition to a translation of the *Discourse*, two of the *Meditations* (the first and second from *Meditations on the First Philosophy*) and five Letters of some significance. There is a fine wood-cut portrait of Descartes as frontispiece.

Perhaps some day the story of the role intuition has played in the advancement of science may be written. When it is, Descartes must not be forgotten. As Valéry points out, Descartes' whole life achievement of the method for rightly regulating his reason and seeking scientific truth hinged upon the three dreams that visited him on a certain night of his youth (November 10, 1619) after a day of fervent mental effort and creative formulation—dreams that, Descartes said, had been exactly foretold to him by the Genius who that day possessed him. This is one of the most astonishing events in all the history of science. Perhaps it is paralleled only by Kekulé's half-waking, half-dreaming vision of the dancing carbon atoms that whirled themselves into the benzene ring. It would have appealed to William James, to write of "The scientist as dreamer...."

BENTLEY GLASS

A SCIENTIST'S APPROACH TO RELIGION.

By Carl Wallace Miller. The Macmillan Company, New York. \$2.00. viii + 127 pp. 1947.

The author, Professor of Physics at Brown University, supports the fundamental orthodox Christian beliefs with reasoning that, while it will not always convince the skeptic, will greatly serve to strengthen the wavering. He is intelligent and broadminded and worth listening to, even though the extrapolation of the principles of physics into the realm of the spiritual is not without certain risks.

BENTLEY GLASS



THE SCIENTISTS SPEAK.

Edited by Warren Weaver. Boni & Gaer, New York. \$3.75. xiv + 369 pp. 1947.

The Scientists Speak is the record, in book form, of the greatest effort that has yet been made to provide lay education in modern science. It is a collection of 79 brief addresses by leading scientists of the United States on subjects of their own immediate interest. The talks were originally given to radio audiences in the intermission periods of the New York Philharmonic-Symphony Orchestra concerts, from 1943 to 1946. They were carefully planned, with the special assistance of George W. Gray, to be general and non-technical, educational and inspirational in character.

Warren Weaver, chairman of the Advisory Committee which selected the speakers and helped to plan the talks, has supplied an introductory chapter, on Science and Complexity, which serves to introduce the authors and to place the entire series in focus. The talks, over one-half of which are biological in nature, are then grouped into related units, as follows: The Science of the Earth; The Science of the Sky; The Science of New Materials and Improved Processes; New Instrumental

Techniques—New Chemicals; Atoms and Molecules; Physics and Mathematics; Chemistry and Living Things; Plants and Animals; Fundamental Biology; The Science of Ourselves; Science and Health; The Natural and the Social Sciences; Science and the War; The Long-Term Values. The total result is a panorama of modern science of magnificent scope and general interest, a fact witnessed by the quarter of a million requests from listeners for copies of the talks, received by the CBS from all parts of the continent and from an astonishing variety of people of diverse social and economic status.

Teachers will find *The Scientists Speak* a veritable mine of useful and interesting scientific information and, as well, of invaluable examples of how to present scientific material clearly and simply to a lay audience. To the U. S. Rubber Company, sponsor of the programs, to George W. Gray, to the Advisory Committee, and most of all to the individual speakers themselves, the praise and thanks of American biologists.

BENTLEY GLASS



AMERICA'S ROLE IN THE GROWTH OF SCIENCE.

PRESENT TRENDS AND INTERNATIONAL IMPLICATIONS OF SCIENCE.

PROBLEMS OF INTERNATIONAL COOPERATION IN SCIENCE.

PILGRIM TRUST LECTURE.

(*Papers read before The American Philosophical Society and The National Academy of Sciences, October 17-23, 1926.*) *Proceedings of the American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge, Volume 91, Number 1.*

The American Philosophical Society, Philadelphia.

\$1.50 (paper). iv + 136 pp.; ill. 1947.

Contents: The American Philosophical Society and International Relations (E. G. Conklin); America's Role in the Development of Astronomy (H. N. Russell); Growth of the Physical Sciences and their Applications in the United States (K. K. Darrow); Botanical Sciences and their Applications, including Agriculture (L. H. Bailey); Eighteenth Century Theories on America as a Human Habitat (G. Chinard); Trends in American Medical Research during the Nineteenth Century (R. H. Shryock); The Pilgrim Trust Lecture: The Freedom of Science, by Sir Henry Hallett Dale; Astronomy and International Cooperation (H. Shapley); New International Aspects of Oceanography (H. U. Sverdrup); Geophysics (J. B. Macelwane, S.J.); Mineral Resources in their International Relations (C. K. Leith); Epidemic Diseases (T. M. Rivers); International Problems in Plant Disease Control (E. K. Stakman); The Role of Amino Acids in Human Nutrition (W. C. Rose); Publication and the Distribution of Publications (A. Wetmore);

The International Scientific Unions (J. A. Fleming); International Scientific Congresses (J. C. Hunsaker); The Interchange of Men of Science (R. A. Millikan); The United Nations Educational, Scientific and Cultural Organization (W. A. Noyes, Jr.).



SEX EDUCATION: *A Guide for Parents, Teachers and Youth Leaders.*

By Cyril Bibby. Emerson Books, New York. \$2.50. 311 pp. 1946.

Written as a guide for those interested in sex education, the subject is approached here from a sociological viewpoint. The book is neither a text- or reference book, but a somewhat repetitious discussion of the problems and attitudes which may arise in undertaking sex education. Suggestions are made for the instruction of different age groups and for dealing constructively with attitudes encountered at the various age levels. The appendices contain a tentative scheme (tabulated) for sex education, suggestions for activities, sample lectures, and a good reading list.

This work would undoubtedly be a more satisfactory guide to sex education, however, if factual material concerning the anatomy and physiology of the reproductive and endocrine systems and some venereal disease information had been incorporated in the text. In the opinion of the reviewer, American teachers and parents prefer and can better use a more direct and inclusive presentation than is available here.

HARRIETTE D. VERA



DISCOVERING OUR WORLD: *Science for the Middle Grades. Basic Studies in Science. Books One, Two, Three.*

By Wilbur L. Beauchamp, Mary Melrose Williams, and Glenn O. Blough. Scott, Foresman and Company, Chicago, Atlanta, Dallas, and New York. (1) \$1.48; (2) \$1.52; (3) \$1.64. (1) 224 pp.; ill. (2) 256 pp.; ill. (3) 304 pp.; ill. 1947.

These three books contain respectively eight, nine, and ten units, of which about half are biological in subject matter. There is relatively more biology to start with, and more physical science in Book Three. The study of biology (I) begins with the kinds of organisms, their need for water and air, the structures and functions of the human body, health and disease, animal and plant growth; (II) continues with plant and animal interrelations, movement, foods and nutrition, the sources of foods in plant processes, and gardening; and (III) ends with sound and hearing, light and vision, germs, plant and animal reproduction, and the evolution of life on the earth. The vocabulary is well

graded as to difficulty and the style is interesting. Especially commendable is the frequent use of the experimental approach and the suggestion of further simple experiments and activities for the young students. Each volume has a good index and a glossary of science words.

The illustrations are entirely in color. This may appeal to children in the middle grades; but the shades are gaudy rather than realistic and the colors are almost uniformly out of register.

BENTLEY GLASS



VITALIZED GENERAL SCIENCE.

By Barclay M. Newman; edited by Sebastian Hasckelberg and Esther Boal. *College Entrance Book Company, New York.* 75 cents (paper). iv + 380 pp.; ill. 1947.

Although printed on cheap paper and bound in a way hardly likely to hold up under rough use, this general science textbook for a first year high school or junior high school course has excellent diagrams and catchy illustrations and is written in a clear, straightforward style. Of its four main parts, one is devoted to the science of life. This, unfortunately, is sadly unbalanced. For example, considerable detail about foods and digestion is offset by the complete disappearance of the kidneys from the body, excretion being regarded, apparently, as synonymous with defecation. Nor does the human body appear to possess either muscles or skeleton, although its nervous system and glands are well developed. More attention to a balanced treatment would make this a really good textbook. As it is, it cannot be recommended.

BENTLEY GLASS



OUR WORLD CHANGES. *Adventuring in Science. New Edition.*

By Samuel Ralph Powers, Elsie Flint Neuner, Herbert Bascom Bruner, and John Hodgdon Bradley. *Ginn and Company, Boston, New York, Chicago, London, Atlanta, Dallas, Columbus, and San Francisco.* \$1.96. vi + 585 pp.; ill. 1946.

This newly revised junior high school science textbook is the second in a series of three, the other two of which have already been reviewed here recently (see Q.R.B. 22: 60, 141. 1947). It contains six units that deal with the phenomena of change in nature, three of them with respect to living organisms (The Changing World of Life; Our Life in a Changing World; Conservation in a Changing World). In addition, one section of the unit on The Changing Landscape is devoted to the story of organic evolution.

The book succeeds to an unusual degree in revealing the relations of plant and animal life to the environment. For example, the study of weather and climate leads naturally into a consideration of the effects of changing seasons upon plants and animals. A minor criticism might be made of the choice of desert and ocean habitats to exemplify adaptation. Perhaps these were chosen on the basis of dramatic interest, but grassland and forest might be closer to the common experience of American children, and have greater practical value. The inclusion of the section on fossils and prehistoric man is unusual in a book at this level, and is very welcome. The book's illustrations are very good, and there are lists of suggested experiments, readings, and science words, and an index. In sum, like the other books of this set, *Our World Changes* is individually excellent. Collectively, the set fails to cover biology in a fully comprehensive fashion. The emphasis is heavy on ecology, human anatomy and physiology, health and disease, conservation and economic aspects, and is correspondingly weak elsewhere.

BENTLEY GLASS



MODERN BIOLOGY.

By Truman J. Moon, Paul B. Mann, and James H. Otto. *Henry Holt and Company, New York.* \$2.96. xvi + 664 + xlii pp.; ill. 1947.

This high school biology textbook presents a varied and comprehensive survey of the science of life. Its eleven units cover: The Scientific Study of Living Things (protoplasm, the chemistry of life); The Relationships of Living Things; The Biology of Plant Life; How Plants Affect Our Lives; The Microscopic World of Life; Simpler Forms of Animal Life; Animals With Backbones; How Biology Applies to Ourselves (human anatomy and physiology); Biology and the Problems of Disease; The Biology of Heredity (and evolution); and Safeguarding Nature's Inheritance (conservation). The text has been brought right up to date, and one will find discussions of the Rh blood factors, penicillin and streptomycin, DDT, riboflavin, nicotinic and pantothenic acids, plant hybrids, and other recent developments. Certain classic errors and misinterpretations have nevertheless been held over from the past, e.g., the wholly imaginary spireme; the dubiously hereditary defects of Jukes and Kallikaks; the unsubstantiated regulation of growth by the pineal body. The dating of the geologic eras is far out of line with the best estimates.

More surprising are certain peculiar gaps in the survey. Reproduction, for example, is scarcely mentioned in the consideration of man's own biology. The reproductive organs are completely omitted (save as endocrine organs), although all other systems are considered fully. A chapter is devoted to mammals,

yet no mention is made of marsupial and placental reproductive patterns. Embryos are considered as evidences of evolution, but there is no story of embryonic growth and development. Sex education is as neglected here in the high school as in the grades (cf. review of the *Health of Our Nation* series, above).

The two-column format is good, and the line drawings are excellent. But the numerous half-tones, because of unsuitable paper, show up very poorly. In spite of these defects, *Modern Biology* will deserve to continue to hold its high place among biology textbooks at this level.

BENTLEY GLASS



WORKBOOK IN THE INTRODUCTION TO THE BIOLOGICAL SCIENCES.

By Austin Ralph Middleton. *The Hobson Book Press, New York.* \$3.00. xxvi + 478 pp.; ill. 1947.

This lithoprinted "workbook" contains notes on 41 lectures organized into ten units, as follows: Introduction to the Biological Sciences; The Kinds of Organisms; Classification of Organisms; Structure of Organisms; Distribution of Organisms; Problems of Organisms; The Importance of Organisms to Man; Structures and Functions of the Human Body; Genetics and Eugenics; Evolution. From p. 261 on, the book takes on the form of work-sheets, perforated for easy removal, and consisting of questions to be answered by the student, and occasional drawings to be labeled. A few original drawings are called for. The necessary space for answers and drawings is provided. Most of the "laboratory" work envisioned would appear to consist of book-work and discussion. Experiment and original observation have been reduced to a minimum—in fact, almost eliminated. For those who believe in the merits of such a course in biology, the book may merit consideration. To most teachers it will probably seem that the unillustrated lecture notes fall as far short of adequacy, as a textbook, as the work-sheets fail to indicate worth-while laboratory procedures.

BENTLEY GLASS



GENERAL BIOLOGY. *Second Edition.*

By Perry D. Strausbaugh and Bernal R. Wiemer. *John Wiley & Sons, New York; Chapman & Hall, London.*

\$4.75. viii + 718 pp. + 20 plates; text ill. 1947.

Without radically changing the plan of the first edition (reviewed, Q.R.B. 13: 455. 1938), the authors have greatly improved their widely used text by carefully eliminating small errors and misleading statements, by

reducing the frightening number of boldface technical terms which studded the text, and by redrawing, with a marked increase in clarity, a good many of the figures. A glossary has been added, although there are still no references for supplementary reading. The chapter *What Is Biology?* now stands at the beginning of the book, and the discussion of the hormones has been enlarged to form an entire chapter. The subject matter has been brought up to date in most instances, although the mythical spireme has been retained, along with Jukes and Kallikaks, and the section on the evolution of man, considering its broad interest, seems very sketchy and not altogether up to date. The section on eugenics still seems the weakest in the book, and it could very well be curtailed so as to allow human evolution more scope. On the whole, the authors must be commended for an unusually painstaking job of revision, and congratulated for having made so material an improvement.

BENTLEY GLASS



BIOLOGY: HISTORY AND BIOGRAPHY

A FIFTEENTH CENTURY SURGEON: *Hieronymus Brunschwig and His Work.*

By Henry E. Sigerist. Ben Abramson, New York. \$25.00 (with an original leaf from Brunschwig's *Chirurgia*, containing a large woodcut illustration); \$15.00 (with an unillustrated original leaf); \$3.50 (without any original leaf). 48 pp.; ill. 1946.

This excellent little essay on the 15th century surgeon, Hieronymus Brunschwig of Strasburg, is beautifully bound, printed, and illustrated. Forming originally the introduction to a facsimile edition of Brunschwig's *Book of Chirurgia*, it is in its new independence probably primarily destined for the bibliophile.

ERWIN H. ACKERKNECHT



THE SELECTED WRITINGS OF BENJAMIN RUSH.

Edited by Dagobert D. Runes. *Philosophical Library, New York.* \$5.00. xii + 433 pp. + 2 plates. 1947.

This volume of *Selected Writings of Benjamin Rush* has appeared close to the 200th anniversary of Rush's birth, at a time when evaluation of his contributions and his character is highly fashionable. Reports of Rush, "good Dr. Rush," as Thomas Jefferson called him, by his contemporaries and by history, and what emerges of him from his own writings, agree in portraying him as contentious almost to the point of paranoia, but as uncompromising and courageous; as a utilitarian and a universal reformer, but obsessed with a great passion for liberty. "Remember the eyes of all Europe

are fixed upon you," he wrote to his countrymen, "to preserve an asylum for freedom in this country, after the last pillars of it are fallen in every other quarter of the globe." His profession was medicine; his many and diverse avocations all looked toward the construction of a programme for a greater ennoblement of the human spirit.

His strictly medical writings in most ways reflected rather than advanced the general attitudes of the late eighteenth century. The exception lies perhaps in the field of psychiatry. Here his advocacy of the use of occupational therapy as a therapeutic tool, his appreciation of the urgency for treatment of the insane and the alcoholic on a medical plane, his recognition of the facts that "many diseases take place in the body from causes that are forgotten . . . depression of mind may be induced by causes that are forgotten; or by the presence of distress into which it was at one time associated, but without reviving the cause of it in the memory"—all these mark him as a pioneer of wisdom and influence in the treatment of mental disease. The present volume would have done well to substitute excerpts from the *Medical inquiries and observations upon diseases of the mind* for the 15 pages devoted to the heavy humor of the papers on the different species of mania and phobia.

His humanitarianism, compounded out of sensitivity to individual human problems and of a vision of the possibilities for social progress, led him to call for reforms in many other fields than the medical, and many of his appeals are included in this volume: he crusaded bitterly against the evils of human slavery and against capital punishment; he campaigned as vigorously for the improvement of government, of education, of agriculture, of hospitals and sanitation. "Every man in a republic is public property," he wrote, and he was able to write and think always with both man and the republic in mind.

"The turgid style of Johnson—the purple glare of Gibbon . . . are . . . equally unnatural, and should not be admitted into our country," he wrote. His own style reflects his forcefulness of mind and purpose, and while his rhetoric, like his thinking, is sometimes interrupted by interjections characteristic of his century rather than ours, he has much to say to us today. His thought is pervaded by a note of confident optimism. "Why has the spirit of humanity made such rapid progress for some years past in the courts of Europe?" he enquired in 1786. "It is because kings and their ministers have been taught to *reason* upon philosophical subjects," and his hopefulness for the future is implicit in his answer. His times were in many ways akin to our own; we have much to learn from the signers, and all that they have to say is of importance. Perhaps our greatest need now is for leadership of the quality of their own, and what inspiration we may derive from their words cannot fail to help us to emulate them;

the publication of this book is therefore a good contribution to contemporary thinking.

The construction of the book, so far as paper and print are concerned, is not quite worthy of the words and conceptions it carries; the "list of the writings of Benjamin Rush published during his lifetime," which constitutes part of the appendix, should clearly consist of more than a bare list of titles without any sign as to date or provenance.

JANE OPPENHEIMER



THE DEVELOPMENT OF MODERN MEDICINE: *An Interpretation of the Social and Scientific Factors Involved.* By Richard Harrison Shryock. Alfred A. Knopf, New York. \$5.00. xvi + 458 + xv pp. + 10 plates. 1947.

A new edition of this history of modern medicine, originally published in 1936, will be welcomed by all those familiar with the rare qualities of the book. The fact that its author is not a medical man but a distinguished historian makes for emphasis upon the social and general historical implications of the subject. As, on the other hand, the purely medical matter is very competently and extensively dealt with, the book is actually superior to the "pure" medical histories. It might not provoke as much special medical thought as K. Faber's unforgettable *Nosography* or Sigerist's *Man and Medicine*, but as no other book, it will give to the doctor and "layman" (medical students, historians, sociologists, economists, biologists, etc., included) alike an understanding of what has happened to doctors and patients during the last two hundred years.

The book starts with an appreciation of what scientific elements existed in medicine in the 18th century and an analysis of the social and medical factors that retarded their growth. Due emphasis is given to the progress of preventive medicine in the 18th century (as later to the Public Health movement of the 19th century). Then the story of the unfolding of scientific medicine through the application of the basic sciences and of quantitative methods (a point dear to the author), and of the loss and regain of public confidence in the profession is well told, with much skill and scholarship. In the progress of the book, the emphasis shifts more and more to American experience. The last two chapters, the only ones which differ considerably from those in the first edition, because of extensive additions, deal with the rather depressing story of the fight for and against health insurance in this country, and the problems solved and still unsolved through the most recent advances in scientific medicine (like the antibiotics).

ERWIN H. ACKERKNECHT

A SURGEON'S DOMAIN.

By *Bertram M. Bernheim*. W. W. Norton & Company, New York. \$3.00. 253 pp. 1947.

The author, Associate Professor of Surgery at The Johns Hopkins Medical School, has many interesting things to say: personal experiences in getting into surgery by "the back way"; reminiscences of great surgeons at work—J. M. T. Finney, Harvey Cushing, W. S. Halsted; notes on learning the job, and on growing stale. The book never flags. But Bernheim is best when he gets to grips with his convictions and expresses his views on the relations between visiting and resident surgeons, on fee-splitting and the economics of surgery, on the need for nurses. His central conviction is that surgeons should not engage in private practice but should be attached to hospitals and clinics as salaried personnel. While his view will no doubt not be shared by all surgeons, his long experience as Chief of Surgery and his arguments and reasons tend to carry conviction.

Biologists will most likely find their interest keenest in the all-too-short chapter on experimental surgery, in which Bernheim tells of his period of research under Harvey Cushing in the Hunterian Laboratory, and of the trials and rewards of experimental work on dogs. It is characteristic of the author that the chapter ends with him performing an emergency operation on his dog at home, for once the hero in his own family!

BENTLEY GLASS



THRILLS OF A NATURALIST'S QUEST.

By *Raymond L. Ditmars*. *Halcyon House, Garden City, New York*. \$1.49. xiv + 268 pp. + 24 plates. [1932]; 1947.

Many a biologist will be grateful for the reissue in an inexpensive edition of this, perhaps the most popular of all Ditmars' books. This is the sort of story that makes naturalists. It has been previously reviewed in these columns (see Q.R.B. 8: 226. 1932).



ECOLOGY AND NATURAL HISTORY

ELEMENTS OF SOIL CONSERVATION.

By *Hugh Hammond Bennett*. *McGraw-Hill Book Company, New York and London*. \$3.20. x + 406 pp.; text ill. 1947.

As would be expected, the author graphically states the soil erosion problem in the United States, shows its extent, the very serious effects which have already resulted, and the threat of soil erosion to the very heart of our agriculture. Because of their importance, the factors affecting rainfall penetration into the soil are

emphasized. The changing point of view of the professional soil conservationists toward their problem as a whole is reflected in the statement that national action to conserve the soil resource must not only deal with soil erosion and related physical facts but must also cope with the complex economic and social considerations that affect the use of land.

The second half of the book deals with the various means and technics, such as the use of vegetation, contouring, terracing, channels and outlets, gully control, control of stream bank erosion, water spreading, small dams for water storage, farm drainage, and irrigation. Here, too, there can be noted those marked changes in the point of view of soil conservationists that have come about during the last decade. However, not all will agree that soil conservation, as such, is a major agricultural science.

This generously illustrated textbook seems quite suitable for use in American secondary schools. From the list of films and film strips at the end of the volume much effective material for supplementary teaching and propaganda can be obtained. The type is large and easily read, though the quality of the paper, and thus of the halftones, leaves something to be desired.

ROBERT L. PENDLETON



FOREST SOILS.

By *Harold J. Lutz and Robert F. Chandler, Jr.* *John Wiley & Sons, New York; Chapman & Hall, London*. \$5.25. xii + 514 pp.; ill. 1946.

While the jacket states that this is a thorough treatment of soil science in its relation to the growth and distribution of forest trees, and that "important world research is summarized, interpreted, and critically analyzed," in reality this book deals almost exclusively with the temperate zone forests of the United States and Europe. More than eleven hundred references to the literature should prove very useful.

In view of the increasing opportunities for and responsibilities of scientists from the United States to deal with forestry problems in the Caribbean and other tropical regions, it seems odd that no mention has been made of the forestry work in Puerto Rico, nor of the soils studies of Mohr and others in the Netherlands Indies, of Corbet and Haines in Malaya, or of the important forestry work in India. Nor has the reviewer noted any mention of control of erosion and other studies on the forest soils of Japan. Because of the generally impoverished nature of humid tropical soils, tree crops are particularly appropriate on them. And it is from forests on such soils that the temperate zones are dependent for important supplies of the forest products: rubber, quinine, coffee, tea, cacao (chocolate), rotenone, shellac, rattan, etc. In the absence of some

general treatment of forest soils and forests in lower latitudes, the conventional discussion of laterization and laterite soils adds nothing to the stature of the book, and might well have been omitted.

Since this is intended as a textbook, it is not considered necessary to attract the reader nor to hold his attention; but for the general reader a somewhat different presentation of the subject would be more interesting. For example, chapters 2, 3, and 4 might well follow chapter 10.

ROBERT L. PENDLETON



DROUGHT: Its Causes and Effects.

By Ivan Ray Tannehill. Princeton University Press, Princeton. \$3.00. xii + 264 pp.; ill. 1947.

Droughts are terrible catastrophes, but the sensational descriptions of human misery and the other unhappy effects of droughts which fill the first quarter of this book seem labored and affected. Specifically, only the droughts of the United States are considered, and many data are presented, largely in the form of curves, in an endeavor to show the correlation of the different sets of data. Very interesting relationships are shown between relative temperatures of the continents and of the oceans; of sunspot activity; rainfall intensity and distribution in space and time; etc. The significance of differences between values in various parts of the United States is pointed out, and the possible cyclic nature of these variations is considered. It is evident, however, that the sheer magnitude of studying and reducing to useful relationships the enormous masses of meteorological data already accumulated has prevented arriving at all the possible useful knowledge as to when and where droughts may be expected to occur. As the author says, if any one fact stands out in this study, it is that each local area will have to have its own drought problem solved separately from the others. The causes of rainfall are not the same in all parts of the earth, and, therefore, the causes of rain deficiency will not be the same everywhere.

The halftones are excellent and could well be used in a more conventional discussion of the measurement and recording of meteorological data. Many of the graphs would be more easily understood if larger; this would make it possible to label more values on the graphs themselves legibly.

ROBERT L. PENDLETON



A TREASURY OF ENGLISH WILD LIFE. Britain in Pictures.

Edited by W. J. Turner. Chanticleer Press, New York; distributed by Hastings House, New York. \$5.00. 324 pp.; ill. 1947.

This is a collection of six books in one: *Trees in Britain*, by Alexander L. Howard; *Wild Flowers in Britain*, by Geoffrey Grigson; *Wild Life of Britain*, by F. Fraser Darling; *The Birds of Britain*, by James Fisher; *British Marine Life*, by C. M. Yonge; and *Insect Life in Britain* by Geoffrey Taylor. It constitutes a magnificent portrayal of natural history in the grand manner. There has been no effort to provide complete handbooks or keys for identification. On the contrary, the authors are as interested in the reflections of the natural history of their country in literature and in art as in nature itself. The object has been to introduce the reader to the richness of natural history, to delight, to amaze, even to intoxicate with its strangeness and beauty. The result is a book to be treasured always by its possessors, not only for the text but even more for the delicate and lovely masterpieces of drawing and painting reproduced from the work of the greatest British naturalists and artists of the past two centuries. The color plates must be seen to be believed. I cannot forbear mentioning in particular the work of a modern artist among them, Vere Temple, whose two plates (butterflies and dragonflies) achieve a mastery of color and design worthy of Hokusai. No book could offer more for the modest price asked.

BENTLEY GLASS



TREES IN BRITAIN. Britain in Pictures.

By Alexander L. Howard. Collins, London; [Hastings House, New York.] \$1.50. 48 pp. + 8 plates. 1946.

See the review of *A Treasury of English Wild Life* above.



EVOLUTION

ESSAYS ON HUMAN EVOLUTION.

By Sir Arthur Keith. Watts and Company, London. x + 224 pp. 1946.

An alternate title for these essays might be: Evolution, Ethics, and War. In them Sir Arthur Keith has endeavored, under the stress of the mixed emotions of war-time, to assess a lifetime of thought upon the relation of evolution to human progress and civilization. The gist of his philosophy is as follows: Man's evolution has proceeded under a dual ethical code, a code of co-operation and kindness as regards the in-groups, and a code of hate, enmity, and war directed against outsiders. Man's primitive instincts are of these two sorts. Civilization has arisen through the struggle, first between tribes and then between kingdoms and finally nations, as the in-group has expanded and the rivalry between increasingly powerful evolutionary units became more

deadly. Tribal isolation, now replaced by national isolation, has been and remains essential for the continuation of evolutionary progress. "Nations, if not actually distinct species," he quotes with approval, "may be varieties of the human race on the way to acquire specific distinction. . . . The German Nation is a biological unit at this critical stage of its evolution." War is the epitome of the struggle for existence in human affairs, and, whether we like it or not, a necessary outcome of Darwin's theory. "Where there is no aggression, as among the Australian aborigines, evolution tends to become stationary" (p. 165).

To point out all the unsubstantiated assumptions that underlie this philosophy would far exceed the scope of a short review. Nevertheless, certain major assumptions are so critical to Keith's point of view that merely to indicate them may be enough to reveal how unsubstantial is the logical edifice he has erected. In the first place, the noted anthropologist assumes that evolution—human evolution, at least—cannot change its direction. It must follow out the trend established in the past, or the species will come to a sad end. This view is a necessary consequence of his firm belief that "the essence of living protoplasm is its purposiveness" (p. 217), evolutionary as well as immediate. Few biologists will care to follow him here. Quite aside from the probability that, as G. G. Simpson has said, "A dispassionate survey suggests that much of the rectilinearity of evolution is a product rather of the tendency of the minds of scientists to move in straight lines than of a tendency of nature to do so," a sound concept of the relation of environment to the character of natural selection necessitates the view that a radically changed environment will alter the trend of evolution taken by organisms in it. In other words, even if we suppose that man has evolved under a dual ethical code up to recent times, there is no reason to believe that, in the vastly different physical and cultural environment with which man has surrounded himself today, the primitive trends must be preserved.

Secondly, there is Keith's unsubstantiated assumption that the nation is "an isolated group; it is an evolutionary unit" (p. 133). A nation is a political unit; perhaps it may even be a cultural unit—but that it is a biological unit of any sort is a quite unwarranted concession to Nazi philosophy. Gene frequencies vary from part to part of nations as greatly as from nation to nation. No one who has ever lived in China could make the astounding statement that "the inhabitants of China form one continuous uniform [sic] mass" (p. 181). While as for the United States—

A third unsound assumption basic to Keith's argument is that which identifies cultural change and progress in civilization with the biological evolution of the human species. How can an eminent anthropologist know so little of the strength of patterns of culture? Is there an iota of evidence that the "instincts" which lead

to war are based upon heritable entities, genes or whatever? Is there any reason to suppose that because of war gene frequencies change materially? Populations live on, conquerors and conquered alike, and the killing of people is not the same thing as a change of gene frequencies in the surviving peoples? Keith has here assumed the very point to be proved. Finally, is there a shred of evidence that, in the 25,000 years or so of man's civilized existence, he has evolved biologically in the least? There is plenty of genetic heterogeneity, now as at the beginning of civilization. Mutation holds a balance against gene elimination by selection. Tribes and nations may disappear as distinguishable political or cultural units, but their genes are dispersed and intermixed with those of their successors rather than eliminated. In short, the trend has been from many small isolated groups toward "One World," and if any gene frequencies are changed in the process at all, there should be a selection of those that support the "ethical" code of human cooperation and brotherhood.

BENTLEY GLASS



ORGANIC EVOLUTION.

By Richard Swann Lull. *The Macmillan Company, New York.* \$8.00. xx + 744 pp. + 31 plates; text ill. 1947.

A reprinting, with very minor changes, of the edition of 1927 can be of little service at this date. Modern evolution theory is conspicuous by its absence from the book. Even the paleontological treatment has not been brought up to date.

BENTLEY GLASS



GRAPTOLITES OF NORTH AMERICA. *Geological Society of America Memoir 19.*

By Rudolf Ruedemann. *Geological Society of America, New York.* \$9.00. x + 652 pp. + 92 plates. 1947. This paper describes and illustrates some 700 species of graptolites and presumably includes all of the North American species which had been established prior to 1942. Ruedemann has based his work primarily upon a study of the large collections of the United States Geological Survey but in addition has examined numerous other collections. The illustrations are in the form of line drawings, some of which are lacking in detail.

The systematic descriptions and illustrations take up some two-thirds of the monograph, the remainder being devoted to a general discussion of graptolites, including methods of investigation, terminology, morphology, phylogeny and affinities. This section of the text is necessarily brief but includes a rather complete bibliography up to about 1942. It is unfortunate that the

recent work of Bulman on the order Dendroidea could not have been included in this publication, but presumably the manuscript was in press prior to its publication.

THOMAS W. AMSDEN



CORALS FROM THE GULF OF CALIFORNIA AND THE NORTH PACIFIC COAST OF AMERICA. *The Geological Society of America Memoir* 40.

By J. Wyatt Durham. *The Geological Society of America, New York*. \$1.70. vi + 68 pp. + 14 plates. 1947.

The bulk of this short memoir is devoted to a description and illustration of corals collected by the author from the Gulf of California and the North Pacific Coast region. In addition some specimens from the coasts of Mexico and Panama were examined, but much of the information on these corals has been taken from the literature. The present distribution of the genera and species of this Pacific Coast fauna is discussed, and some information on the ecology is presented. The author also lists the genera found in the Cenozoic deposits of California, Oregon, and Washington and compares the geographic distribution of the fauna during the several epochs of the Cenozoic with that found today. This discussion is, however, too brief to be entirely satisfactory.

THOMAS W. AMSDEN



TEREBRATULOID BRACHIOPODA OF THE SILURIAN AND DEVONIAN. *Geological Society of America Special Papers*, Number 38.

By Preston E. Cloud, Jr. *The Geological Society of America, New York*. \$1.50 (paper). xi + 182 pp.; 26 plates. 1942.

This carefully prepared volume fills a conspicuous gap in the knowledge of the brachiopods. Cloud describes and illustrates here all of the known Silurian and Devonian terebratuloid brachiopods and establishes 8 new genera and 11 new species. The material is well illustrated with numerous plates and text figures.

In addition to the systematic descriptions there is a chapter devoted to a discussion of the morphology and phylogeny of this group. There is also a section dealing with the methods used in preparing the specimens for study and illustration. Of special interest to those engaged in a study of fossil brachiopods is the technique used in making scale models.

THOMAS W. AMSDEN



CRETACEOUS AND TERTIARY ACTINOPTERYGIAN FISHES FROM BRAZIL. *Bulletin of the American Museum of Natural History*, Volume 89, Article 1.

By Bobb Schaeffer. *American Museum of Natural History, New York*. \$1.00 (paper). 40 pp. + 7 plates; text ill. 1947.

The collection of fossils upon which the systematic portion of Schaeffer's paper is based contained few new forms or specimens of note. His study of the material, however, led him to the investigation of topics of broader interest. The occurrence of *Knightia* and *Diplomystus* in his materials is responsible for a study of generic characters and trends in these teleost genera and of the general evolutionary story of the double-armed clupeids, widespread in the Tertiary.

The origin of the South American teleost fauna is a major problem in zoogeography. Most of the fossil material from that continent is from Brazil, and Schaeffer makes a valuable contribution by gathering and summarizing the data on Brazilian fossil teleosts, together with a resumé of the geological sequence. The evidence afforded by the fossil record suggests to him that the origin of the South American fresh-water fauna may be traced in great measure to marine radiation rather than to migration over theoretical land bridges.

A. S. ROMER



REVIEW OF THE LABYRINTHODONTIA. *Bulletin of the Museum of Comparative Zoölogy at Harvard College*, Volume 99, Number 1.

By Alfred Sherwood Romer. *Museum of Comparative Zoölogy at Harvard College, Cambridge*. \$4.00 (paper). 368 pp.; ill. 1947.

A. S. Romer is one of the world's outstanding authorities on the fossil amphibians and reptiles, so his recently published *Review of the Labyrinthodontia* is an event of unusual importance to all students of the early land-living tetrapods. By a remarkable coincidence, this work follows by a few months E. C. Case's monographic study of the labyrinthodont amphibians, recently published in the Transactions of the American Philosophical Society (see review, Q. R. B. 22: 216. 1947). Both of these authors carried on their researches quite independently of each other. Romer uses the superordinal term Labyrinthodontia, in contrast to the name Stegocephalia of Cope, favored by Case. In this he is following Watson, who in 1919 revived Owen's name for these primitive Paleozoic and early Mesozoic amphibians.

In the first part of his work, Romer presents an interesting and very useful section on the history of the classification of labyrinthodont amphibians, in which he reviews the classifications set forth by von Zittel (1902), Watson (1919, 1926, 1929, 1940), Abel (1919), von Huene (1920), Smith Woodward (1932), Sæve-Søderbergh (1934), and Kuhn (1939). This portion of the work forms a background for Romer's own treatment of the labyrinthodonts as presented in this paper, a modification of his classification of 1945.

There then follows a long and extraordinarily valuable section on the general morphology of the labyrinthodont amphibians. This includes thorough discussions of the osteology of the skull, of the axial skeleton, and of the appendicular skeleton. In this section Romer takes up the question of vertebral structure in the labyrinthodonts as a basic factor in the classification of these animals. He shows how the rhachitomous vertebrae (particularly the early types that he calls proto-rhachitomous) are an ancestral character in the history of the labyrinthodonts. From early rhachitomous types he would derive the rhachitomous and stereospondylous vertebrae on the one hand, the embolomorous and seymouriamorph vertebrae on the other.

The bulk of the work is devoted to discussions of the genera of labyrinthodont amphibians. Each genus is considered separately, is briefly described, and its relationships with other genera are considered. Figures of the skull roofs of a great many of the genera are included in this part of the monograph. Needless to say, this section of Romer's paper will be indispensable to students of the early amphibians, and the remarks outlining the author's views of relationships are particularly helpful. It would have been very helpful if there could have been included a brief taxonomic review for each genus.

Following the discussions of the genera, there comes the section on the classification of the labyrinthodonts. Romer has here adopted a dichotomous arrangement of the superorder Labyrinthodontia, with two orders, the Temnospondyli (here he revives an old term) and the Anthracosauria. In the Temnospondyli are the suborders Ichthyostegalia, Rhachitomi, Stereospondyli, and Trematosauria; in the Anthracosauria, the suborders Embolomeri and Seymouriamorpha.

Among the Temnospondyli, the Rhachitomi are considered as the central line of evolutionary development, probably springing from ichthyostegid-like ancestors. It is shown, however, that the Ichthyostegalia as we know them, though primitive, are too far advanced to be the actual ancestors of later labyrinthodonts. Consequently these primitive forms are included within the Temnospondyli, but as a phylogenetic line apart from and "balancing" all of the other temnospondyls. The Rhachitomi are shown as trending into the Stereospondyli, and the Trematosauria are differentiated from the stereospondyls as a separate line of evolution. Here Romer stresses parallelism in evolution, which he considers of great importance in the phylogeny of the labyrinthodonts.

In accord with his previous publications, Romer suppresses the phyllospindyls, since he regards these as merely larval or small labyrinthodonts of various sorts.

In setting the embolomeres and seymouriamorphs apart from the other labyrinthodonts, Romer emphasizes the evolutionary direction followed by these amphibians, that eventually led to end forms quite different

from the characteristic temnospondyls. He recognizes the fact that the embolomeres are very primitive labyrinthodonts, but he sees in them the indication of trends quite separate from the general rhachitome evolutionary line. These trends in the embolomeres finally led to the seymouriamorphs, which in turn were the direct ancestors of the cotylosaurian reptiles. Romer prefers to regard the seymouriamorphs as amphibians, though many authors would look upon them as representative of the very primitive cotylosaurs.

There is a final section in Romer's monograph on the stratigraphic occurrence of the labyrinthodonts. This adds greatly to the value of the work as a whole. An extensive bibliography is appended.

Throughout, Romer's work shows the result of his long study of the labyrinthodont amphibians. It is a major contribution of great significance, that together with Case's work will form a base for all studies on labyrinthodont amphibians in the future. For this reason, it is to be regretted that the format has imposed so great a reduction of the many fine figures of skulls in this monograph.

EDWIN H. COLBERT



STUDIES OF THE PHYTOSAURS *MACHAEROPROSOPUS* AND *RUTIODON*. *Bulletin of the American Museum of Natural History*, Volume 88, Article 2.

By Edwin Harris Colbert. American Museum of Natural History, New York. \$1.00 (paper). Pp. 53-96 + 8 plates + 2 charts; text ill. 1947.

Despite the excellent work done by earlier authors on the phytosaurs—crocodile forerunners which are the commonest of American Triassic fossil reptiles—much remains to be done before the possibilities of research on the group are fully explored. Colbert here makes two distinct contributions toward this end. First, the description of a large skull of *Machaeropsopus* leads to an analytical study of the systematics and phylogeny of this characteristic Chinle genus. He concludes tentatively that the various forms described from successive levels of the Chinle formation represent a growth series within a chronocline in the development of a single species, rather than a succession of discrete species. Secondly, the remounting and further preparation of a skeleton of *Rutiodon* from the Triassic of North Carolina permits the description of new features and characters not available to McGregor at the time of publication of his 1906 monograph. In connection with this, a long-neglected skull of this genus, in the Williams College collections, was studied. *Rutiodon* presents an interesting parallel in skull development to modern long-snouted fish-catching crocodilians, although specialization here is not as marked as in the European *Mystriosuchus*.

A. S. ROMER

SEBECUS, REPRESENTATIVE OF A PECULIAR SUBORDER OF FOSSIL CROCODYLIA FROM PATAGONIA. *Publications of the Scarritt Expeditions Number 35. Bulletin of the American Museum of Natural History, Volume 87, Article 4.*

By Edwin Harris Colbert. *American Museum of Natural History, New York.* 90 cents (paper). Pp. 217-270; text ill. + 6 plates. 1946.

It was long believed that the phylogenetic story of the crocodiles was (apart from a flurry of radiation in the Jurassic) a simple and straightforward one, leading from typical mesosuchian forms in the Mesozoic onward by slow degrees to the modern crocodiles, 'gators, and gavials. A decade ago, however, Simpson announced the discovery in the Eocene of South America of a radically different type of crocodilian, *Sebecus*. This, plus the very recent description by Price of another unusual type (*Baurusuchus*) in the late Cretaceous of that continent, indicates that in the later Mesozoic and early Tertiary South America was the home of a group of predeceous crocodiles very different from the normal types, and representing an independent suborder. Simpson's original description was brief and unillustrated; Colbert here gives a definitive account of the *Sebecus* material. In contrast with the flat-headed build of other crocodilians, the *Sebecus* skull was high and narrow, with laterally-facing orbits; the teeth large and laterally compressed, in contrast with the usual crocodilian pegs; the internal nares opened broadly onto the palate. What little is known of the postcranial skeleton is more normal in nature; but so divergent is the skull structure that it seems necessary to erect for this form a new suborder, the Sebecosuchia.

A. S. ROMER



THE MONOTREMES AND THE PALIMPSEST THEORY. *Bulletin of the American Museum of Natural History, Volume 88, Article 1.*

By William King Gregory. *American Museum of Natural History, New York.* 70 cents (paper). 52 pp. + 2 plates. 1947.

The preparation of his eagerly-awaited opus on the evolution of the vertebrates has led W. K. Gregory, in passing, to study many an interesting problem. Here he discusses the origins of the monotremes—a perennially tantalizing puzzle, made unusually difficult because of the reduction of the dentition, which so often furnishes good clues, and because of the almost complete absence of fossil evidence. A majority of workers, as Gregory notes, believe the monotremes to be a primitive group, widely removed phylogenetically from other mammals. Here he ably presents the "minority report," advocating their descent, by a rapid evolutionary development during the Tertiary, from an Australian marsupial stock. The palimpsest mode of study is the

endeavour to discern, beneath the superficial habitus, the underlying basal heritage. From a comparative study of various features of both hard and soft anatomy, Gregory concludes that the heritage is that of marsupial forbears.

Despite Gregory's excellent presentation of anatomical evidence, the reviewer confesses that he is far from fully convinced; reproductive habits, about which Gregory says almost nothing, form a major stumbling block. It is hard to imagine that the egg-laying habit of the monotremes is not a truly primitive character; and if this be true, the argument for Australian marsupial relationship makes it necessary to believe that viviparity has developed, not once, nor twice, but several times in the Mammalia. Parallelism may have occurred; but the reviewer would rather believe that the parallelisms in the situation here have been in less fundamental features, and that the basic heritage resemblances between marsupials and monotremes date from a relatively remote stage.

Perhaps the seemingly barren Tertiary of Australia may some day give us fossil data to aid in a definitive solution of this problem.

A. S. ROMER



GENETICS AND CYTOLOGY

ORGANISME ET SEXUALITÉ. *Encyclopédie Scientifique publiée sous la direction du Dr. Toulouse. Bibliothèque de Biologie Générale.*

By Maurice Caullery. G. Doin & Cie., Paris. Paper. x + 342 pp.; ill. 1942.

This small volume is one of a series which has been appearing over a number of years under the general title *Encyclopédie Scientifique*. Illustrating the scope and variety to be found in these volumes, we may mention others in the field of biology (published or in preparation) that deal with such subjects as cellular biology, living cells in vitro, parthenogenesis, parasitism and symbiosis, insect societies, the species problem, heredity, etc.—all written by distinguished biologists. In keeping with the general plan, the present volume undertakes to survey the current state of knowledge in a particularly complex field for the general biological reader. This is a difficult task.

The manifestations of sexuality in living organisms—morphological and physiological; genetic, ontogenetic, or evolutionary—are incredibly varied. Different lines of approach developed for these major aspects of the problem long ago resulted in the creation of sharply defined provinces, the boundaries of which have begun to dissolve only in recent years. Consequently, the considerable knowledge accumulated in a few well-exploited areas is as yet difficult to correlate comprehensively. In only a few major taxonomic groups is

theoretical analysis possible in any detail; and postulates reasonably grounded in one group cannot yet be safely extended to others, or only in the most general terms. Accepting these limitations, the present volume attempts only to present clearly and concisely the status of certain outstanding problems, some classical (e.g., the problem of germ line vs. soma), others as modern as endocrine interrelations in the reproductive cycle, or the experimental analysis of sex differentiation. As a result, some areas are passed over in summary fashion, some treated as adjuncts of others; however, unity is achieved by virtue of organization around certain central problems which have been approached through more than one field. The material chosen for presentation is selected on the basis of its apparent reliability and lasting significance; sometimes, it would seem, for its consistency.

The book consists of an introductory section on sexuality in unicellular organisms and the simpler metazoa, in particular the nature and characteristics of gametes; after which the evolution and ontogenetic history of gametes is outlined by reviewing the classical concepts of primordial germ cells, germ line, and gonad formation, and the essentials of gametogenesis and meiosis. The first major division of the book describes sex-dimorphism and its multiform expressions, especially in vertebrates. The phenomena of hermaphroditism vs. gonochorism, and secondary sex characters and their dependence on the gonads (or lack of it) are treated, with an analysis based mainly on the literature of castration. The next section is physiological in its approach, and also refers almost exclusively to the vertebrates. The theme is the role of sex hormones as integrators in adult physiology, specifically, the female sex cycle in mammals and the hypophysis-gonad relationship. There is a chapter on the chemistry of the sex hormones. The third part presents the elements of the theory of zygotic sex determination. The statistics of determination, together with data on fetal sex ratios and ratios at birth, are discussed for a number of species.

Part 4 (100 pp.) is devoted to the problems of sex-differentiation and intersexuality, with the treatment based mainly on the modern experimental analysis in three classes of vertebrates—amphibians, birds, and mammals. Naturally occurring forms of intersexuality are discussed as an introduction to the experimental attack; and use is also made of the information and concepts previously developed, so that this section is, to a degree, a synthesis. The effort to bring the phenomena of gynandromorphism, and the classical cases of intersexuality in *Bonellia* and *Lymantria*, within the theoretical framework is permissible only because of the very general terms of treatment.

As an exposition for the general reader, this book succeeds very well. Its simplicity and economy of language are admirable. The question may arise whether the subject has been made too clear. The bibliography is well selected and arranged by chapters,

and there is a systematic and topical index, and an index of authors. Obvious physical defects are incidental and unavoidable. Published in 1942, it suffers greatly in material quality, especially as to paper and illustrations. As a result of the war it has only recently become available in this country, and consequently it is in some respects already seriously out of date. But when all is considered, it is perhaps an achievement that it could be produced at all.

ROBERT K. BURNS



CYTOLOGICAL TECHNIQUE. *The Principles and Practice of Methods used to determine the Structure of the Metazoan Cell. Second Edition. Methuen's Monographs on Biological Subjects.*

By John R. Baker. Methuen & Company, London; The Chemical Publishing Company, Brooklyn, New York. \$2.25. viii + 211 pp.; ill. 1945.

This small handbook of cytological methods, now available in the United States, requires but a single word of praise. It is virtually the only manual to approach the subject courageously from the histochemical point of view. This alone should make it indispensable to the cytologist and histologist. Add to that many interesting sidelights on the historical development of cytotechniques and the characteristic differences in experience with materials, such as the newer synthetic mounting media, that inevitably mark workers in different countries, and no more need be said.

BENTLEY GLASS



GENERAL AND SYSTEMATIC BOTANY

PLANT BIOLOGY. *Second Edition.*

By Paul Weatherwax. W. B. Saunders Company, Philadelphia and London. \$4.25. x + 451 pp.; ill. 1947.

Purposely scaled in proportion and treatment to a single semester course in botany, this second edition, like the first, is designed to meet the needs of the average student rather than those of the botany major. Consequently this book should, because of its simplicity of treatment, fulfil the requirements established in an elementary survey course. The fact that it is but mildly challenging will please those who comprehend with some difficulty. The few added facts and the recasting of old material hardly warrant a new edition at a time when the need for paper is so pressing.

C. P. SWANSON



BOTANY: Principles and Problems. *Fourth Edition. McGraw-Hill Publications in the Botanical Sciences.*

By Edmund W. Sinnott. McGraw-Hill Book Company, New York and London. \$4.50. xviii + 726 pp.; ill. 1946.

The incorporation of recent botanical findings in the fields of antibiotics, genetics, and physiology, the expansion of certain portions of the section on plant geography, and a complete revision of the bryophytes by Hempstead Castle mark the latest edition of Sinnott's well-known botany text. The approach is more definitely physiological than previously, and it is thus in keeping with the present-day trends. With recent emphasis on one-semester courses in the sciences, some instructors will find the book too lengthy, but this objection can be overcome by a judicious selection of subject matter. Certainly in most respects the fourth edition of this book stands high among current texts as one of the more readable and authoritative in its treatment.

C. P. SWANSON



BASIC BOTANY. *An Introduction to the Science of Botany.* By Fred W. Emerson. The Blakiston Company, Philadelphia and Toronto. \$4.00. xii + 372 pp. + 1 plate; text ill. 1947.

The publishing of a new textbook of botany at this time is a courageous undertaking, considering the large number of texts which are already available. Yet the necessity for a new approach to the science, particularly at the elementary levels, is evident; for botany, one of the basic biological studies, has long needed instructional overhauling. The traditional and stereotyped presentation, adequate possibly in the past, has not properly served its purpose of fitting the botanical sciences into the over-all pattern of a liberal education. The textbooks, almost without exception, have been scaled to those students who intend to continue with further specialization, and who in later courses generally repeat the identical subject matter time and again. The student who wishes a science course in order to understand his physical and biological surroundings better, but who has no intention or desire to specialize in botany, frequently finds himself repelled by the detailed facts and theories which, all too frequently, are of interest only to the professional botanist or to the botanical hobbyist. To the average student, botany has far more to offer than this. It has an intrinsic interest, a fascination, and a cultural value which far transcend the technical implications of wood structure or taxonomic differentiations, interesting and important though these may be to the morphologist or the taxonomist, and to the future progress of the science itself. Within recent years the disciplines of cytogenetics and physiology have done much to integrate botany with the more fundamental sciences of chemistry, physics, and mathematics; but with the recent emphasis upon basic science courses for

all students, and upon what may be called a "humanistic" approach to science, it is apparent that the broadening of botany, at least at the elementary level, must also extend in the opposed direction, into the fields of economics, sociology, and even political science.

To demonstrate the point in mind, one needs only to mention two aspects of botany which generally receive but cursory treatment in our elementary textbooks. The parallel rise of civilizations with the domestication of plants presents one of the most fascinating stories of botany. The study of the development of the Indian civilizations of North and South America on an agriculture based on Indian maize not only cuts across the fields of archeology, sociology, history, and even religion, but it also demonstrates and elucidates some of the principles and problems of geographic distribution, plant origins, ecology, and cytogenetics. Likewise, every student of botany who has heard of hybrid corn knows the importance of the scientific principles of breeding techniques and of heterosis. Yet few are cognizant of the significance of this discovery in terms of our national economy, our standard of living, and our agricultural practices. Some will argue that none of this is botany, and in the older sense of the word it may not be; but if, as teachers, we are to integrate our science with our pattern of social existence, and to relate it in all of its ever-ramifying aspects to our every-day problems, the validity of such an argument has no real basis. Knowledge for its own sake is good, but an integrated knowledge is far better.

Emerson's book is done in the traditional manner, and as such provides no real contribution to botanical science, however well written and illustrated it may be. It differs, supposedly, from other texts in that the subject matter is presented from a unified point of view, with protoplasm as the basic unit of function and structure. But such an approach is not new; it is implicit, if not explicit, in most texts, and, indeed, any other would be inadequate when one considers the unity already created within the science by the discoveries of genetical and physiological workers. Granting that the unified plan of presentation is desirable, it is all the more difficult to understand why such an important protoplasmic manifestation as meiosis is as gingerly approached, incorrectly stated, and hastily passed over as it is here, when the simple facts, clearly presented, would have provided the physical basis for understanding the many phenomena subsequently discussed. Likewise, a more realistic integration of all energy transformation phenomena (photosynthesis, digestion, respiration, and the like), instead of the discursive treatment spread over four chapters, would have strengthened the book immeasurably.

Physically, the volume is an excellent one. Attractively bound, very well illustrated, and with the subject matter for the most part effectively and simply handled, it should appeal to the elementary instructor. The use

of our native North American flora in the discussions and illustrations will bring the science closer to the student. Studying aids are incorporated into the chapters, each being headed by an outline of the contained material and concluded by a summary of the important facts, succinctly organized. It is to be regretted that the book can do little, being what it is, to revitalize the botanical sciences.

C. P. SWANSON



GENERAL BOTANY LABORATORY BOOK.

By Edward M. Palmquist and Loren C. Petry. W. B. Saunders Company, Philadelphia and London. \$2.25 (paper). vi + 174-a pp.; ill. 1947.

This is a flexible laboratory guide which can be adapted to almost any course in elementary botany, regardless of the assigned textbook. The material is balanced, the problems of structure and function are nicely integrated, and the drawings for labelling are diagrammatic in their clarity. Innumerable leading questions accompany each section, and assist in directing the student's attention to the important aspects of each laboratory exercise. The wire spring binding is an improvement over the loose-leaf type of laboratory manual, since it is more durable, yet also permits ready detachment of record and problem sheets whenever desirable.

C. P. SWANSON



A TEXTBOOK OF SYSTEMATIC BOTANY. Third Edition.

By Deane B. Swingle. McGraw-Hill Book Company, New York and London. \$3.50. xvi + 343 pp. + 1 pl.; text ill. 1946.

This is the third edition of a textbook of systematics designed primarily for teaching purposes, and describing some 67 orders and families of gymnosperms and angiosperms. Additions to the volume include a section on the mechanism of evolution, discussions of the more recent concepts of the species, a consideration of the experimental methods in taxonomy with the role played by cytogenetics, and the incorporation of floral formulae to the description of each family. The line drawings are well done, but the photographic reproductions, on the whole, are poor.

C. P. SWANSON



LA FLORULE DE L'ÎLE SAINTE-HÉLÈNE. *Contributions de l'Institut Botanique de l'Université de Montréal, Number 57.*

By Ernest Rouleau. Institut Botanique, Université de

Montréal, Montréal. 50 cents (paper). 65 pp. + 1 map; ill. 1945.

This paper is an account of the vascular plants of Sainte-Hélène, a small island in the St. Lawrence River in the vicinity of Montreal. It contains historical notes on the discovery and human occupation of the island, its geological structure, the composition and distribution of its plant communities together with its phytogeographic affinities, a brief resumé of earlier works on the flora, and an annotated list of the plants now known to grow there. The author has himself made many collections from the island, and has utilized many specimens gathered by earlier workers.

The island has been occupied and used by Europeans since the time of the early French colonization of the St. Lawrence estuary. Discovered in 1611 by Champlain, it was first occupied by one François de Lauzon in 1635. Its native forests were probably of sugar maples and associated species, but these forests have been greatly reduced and modified through the years. With alteration of the native vegetation has come a great increase in the number of ruderal plants. The author's analysis of the changes that have occurred and his description of existing plant communities seem adequate and clear.

The annotated list of the flora, which makes up the main portion of the paper, enumerates 383 species, 58 varieties, and 21 forms. Its order of arrangement is that of Fr. Marie-Victorin's *Flore Laurentienne*, while the names used are brought up to date, following revisions that have been made since that work was published. Nearly all of the specimens cited are to be found in the herbarium of the University of Montreal. There are 12 range maps showing the local distribution, in the lower St. Lawrence basin, of species of unusual geographic interest. No keys or synonymy are given, and only a few notes on form and occurrence. There is an index to all species mentioned in the discussion and the list.

H. M. RAUP



THE FUNGI. In Two Volumes.

By Frederick A. Wolf and Frederick T. Wolf. John Wiley & Sons, New York; Chapman & Hall, London. (I) \$6.00; (II) \$6.50. (I) x + 438 pp.; ill. (II) xii + 538 pp.; ill. 1947.

Teachers and research workers in the field of mycology have awaited with considerable anticipation the appearance of Wolf and Wolf's book on the fungi. For the teacher, the summarizing in a two-volume work of the important and significant papers on the morphology and physiology of all the groups of the fungi could provide an invaluable text for both teacher and student. For the research man, it could be a guide to significant

papers in fields, other than his own, into which he wished to probe further. Since the present volumes were published in 1947, both these categories of users can expect that the most modern and up-to-date accounts of the groups of the fungi obtainable will either be given here or that reference will be made to them. This is particularly important in view of the vast amount of mycological knowledge that has accumulated as a result of the war.

Volume One is concerned with the development, structure, reproduction, and taxonomy of the fungi. After a brief preface in which the aims of the authors are stated, namely, to present a reference and textbook with a modern biological approach, there is a chapter on the history of mycology. This is followed by an informative discussion of the methods used in the isolation and cultivation of fungi. A subsequent chapter deals with classification and taxonomy and contains a key to the orders. Other chapters deal successively with the Myxomycetes, Phycomycetes, Ascomycetes, and Basidiomycetes. For each class, a general resumé of the structural features is given, followed by a discussion of the orders and important members of certain families. Special biological features of certain significant genera and species are given in considerable detail, as, for example, the extensive table summarizing information of spermatial formation among species of *Mycosphaerella*. Wherever possible, forms of economic importance are stressed, a feature which is especially helpful to the phytopathologist. After the discussion of each order and often after important families as well, there is a bibliography of presumably pertinent literature. The text is abundantly illustrated throughout with figures which, for the most part, are good and informative.

Whereas the first volume is concerned with morphology and, to a lesser degree, taxonomy, Volume Two deals with the activities of fungi and the effect of these activities upon their immediate environment. As the authors have aptly stated, it is "... physiological and ecological in its emphasis." In it, such fundamental topics as nutrition, enzymes and enzyme activities, and the biochemistry of fungi are discussed. There then follow chapters on the effects of temperature and radiation on various fungus activities and a discussion of the effects of the reaction of the substrate on the fungus itself. With respect to the hydrogen ion, the authors feel, perhaps rightly, that although studies show convincingly that its concentration is an environmental factor of great significance in modifying the metabolic activities of fungi, there is likelihood that too little attention has been given to the effects of other ions and that our present evaluation of this factor is a distorted one. A chapter of unusual interest on methods of spore dissemination follows. This subject is introduced with a resumé of certain quantitative data on the numbers of spores produced by single plants of certain fungi,

numbers that will stagger even a mycologist. Accounts are given of the dissemination of spores in both aquatic and terrestrial fungi. Further chapters deal with spore germination and the factors influencing it and penetration of the host plant, topics which lead naturally to a consideration of physiologic specialization and variation among fungi.

Approaching more closely the ecological is a chapter that deals with phenomena due to different species living together in close proximity. These interactions of fungi on one another have been grouped into three categories, the antibiotic, or harmful effects, the symbiotic, or mutualistic advantages that result from living together of two or more species, and the synergetic. In the last named there "... are included those (effects) in which two or more species through their combined action produce effects or changes that neither could produce alone." There is then a chapter on mycorrhizae and mycotrophy, which is followed by chapters on special aspects of fungus activity, as, for example, one on genetics and several on fungi in relation to man. Under the latter topic are discussed the poisonous and edible fungi, and fungi in relation to disease in man.

After a most interesting and informative chapter on the geographical distribution of fungi, there follows a section devoted to mycology in relation to plant pathology. Here such topics as early concepts of disease in plants, contributory advances in bacteriology, significant events in the development of the field, resistance to disease of the host plant, and a summary of present trends in phytopathology are developed in masterly fashion. There are further chapters on soil fungi, fungus-insect interrelationships, marine fungi, and fossil fungi.

Author and subject indices terminate this volume as they do the first.

In the reviewer's opinion, the basis for any adverse criticism of these two volumes will stem fundamentally from the fact that the authors have assigned themselves a well-nigh impossible task, i.e., to meet the needs of teachers and to provide at the same time a reference book. In attempting to make their work inclusive enough for the research man, they have made it too comprehensive for the beginning student. In attempting to cut it down for the student, they have had to neglect the research man who seeks a relatively exhaustive treatment of an area in which he is particularly interested. There are also those who will question the choice of items included in the bibliographies of certain sections. For example, in the literature cited after an account of the Hymenomycetes, we find such items as Overholt's *Polyporaceae of Ohio*, but nothing of his later, more authoritative, *Polyporaceae of the Middle-Western United States*. Similarly, Kauffman's *Agaricaceae of Michigan* is cited, but no mention is made of his important later generic monographs. The text is exceptionally free of distracting typographical and other errors,

one notable exception being the inclusion in Fig. 58, to illustrate some common poisonous fungi, of *Morchella esculenta*.

Whatever may be the specific criticisms, and however short these volumes may fall of the goal expected of them, no one can question that they are significant contributions to the literature of mycology.

F. K. SPARROW



THE GENUS *CYPERUS* IN MEXICO. *The Catholic University of America Biological Studies Number 1.*

By Brother Benedict Ayers. *The Catholic University of America Press, Washington, D. C.* \$1.25 (paper). xxi + 103 pp. 1946.

Seventy-three species and fifteen varieties of *Cyperus* are treated in Ayers' paper. Not all of them are described in detail, however, though references are given to four earlier papers published by the Catholic University of America, and to one in the papers of the Carnegie Institution of Washington, for full descriptions of the remaining plants. Since most of the work was done during the war, it was impossible to borrow specimens from Europe or from Mexico. Consequently, the physical basis for the study was limited to the herbaria of the United States. Extensive loans were made from the principal of these, and the author had access also to many of the photographs of European types in the Field Museum's collections.

The key to the species is entirely artificial, but the author presents, without discussion, a synoptic arrangement of the subgenera and sections that he recognizes among the Mexican species.

In addition to the synonymy and description of each species, given either by reference or in detail, the author has included a comprehensive citation of specimens, arranged geographically by states, the latter in alphabetical order. The paper closes with a list of species doubtfully occurring in Mexico, an annotated list of the exsiccata cited, and an index to specific names.

H. M. RAUP



TREES AND SHRUBS OF NANTUCKET: *Descriptions, Identification Keys, List of Trees and Shrubs.*

By Mabel Agnes Rice. *Published by the author, Natural Science Department, The Maria Mitchell Association, Nantucket, Massachusetts.* 75 cents (paper). 77 pp. 1946.

Approximately the first half of this little book is devoted to an interesting and informative history of the trees of Nantucket Island. The author makes no claim to having solved the problem of whether the island was ever forested, but she has assembled a formidable array

of facts with which to approach the problem. These facts she has culled from many sources (a bibliography is included), ranging from early town records and early explorations to modern botanical and geological papers. In addition to the historical aspects of Nantucket trees, she has an excellent treatment of their present condition and distribution, with notes on the factors governing their growth and survival. The whole discussion appears to be critically thought out, well organized for logical presentation, and done in excellent style.

The latter half of the book contains a key for the identification of the trees and shrubs of the island. It covers both native and introduced species. The botanical nomenclature is that of the 7th edition of Gray's *Manual* or the 2nd edition of Rehder's *Manual of Cultivated Trees and Shrubs*. The key is followed by lists of the trees and shrubs, wherein the Latin names are followed by a common name and a specific locality on Nantucket Island where a specimen can be seen. By means of single and double asterisks, the author has indicated the species that are native, those that were regarded by Bicknell as introduced at the time he published his list (1908-1919), and those that have been introduced since that time.

The book will be extremely useful for botanically minded travellers and vacationers on Nantucket. It will also serve as a source book for students of the history of vegetation on the southern New England coast. It is handy in size, lithoprinted from typewritten sheets. A map of the island would be a welcome addition if the book were reissued.

H. M. RAUP



CONTRIBUTIONS DE L'INSTITUT BOTANIQUE DE L'UNIVERSITÉ DE MONTRÉAL, *Number 56.*

Institut Botanique, Université de Montréal, Montréal. \$1.00 (paper). 118 pp.; ill. 1944-45.

Number 56 in these contributions contains 10 short papers, the titles of which are self-explanatory. As usual, the papers are published in French. The following is a list of them, with titles in translation:

Two new *Astragali* from Quebec (Jacques Rousseau); Teratological records on the indigenous flora of Quebec (Fr. Marie-Victorin and Jacques Rousseau); *Artemisia* of the section *Dracunculus* in Quebec (Fr. Marie-Victorin and Jacques Rousseau); Some minor phanerogamic entities in the flora of Quebec (Fr. Marie-Victorin); Reconstitution of the prehistoric *Ambrosia* of the Ozarks (Jacques Rousseau); Floristic impressions of Porto Rico (Fr. Marie-Victorin); *Juncus articulatus* L. in Quebec (Fr. Marie-Victorin); Taxonomic notes on the phanerogamic flora of Quebec. I (Ernest Rouleau); An endemic *Lycopus* of the St. Lawrence estuary (Fr. Rolland-Germain); Notes on the genus *Rosa* in Quebec (Bernard Boivin).

PLANTS: *A Guide to Plant Hobbies.*

By Herbert S. Zim. Illustrated by John W. Brainerd.
Harcourt, Brace and Company, New York. \$3.50.
x + 398 pp.; ill. 1947.

Written for the hobbyist who has botanical leanings, but who has had little in the way of formal instruction in the science, *Plants* is an attempt to point out the problems and studies in the botanical field to the layman while at the same time it minimizes the highly technical aspects. In following out his aim, Zim has presented a considerable amount of information in simple language, and has interspersed this with much botanical lore. The reader should not find the text difficult. The presentation is somewhat disorganized, however, and the style unpolished and jerky; the author, it would seem, has glamorized a subject that would appeal but to a limited few. Some errors are evident, but they are such errors of oversimplification as are introduced whenever technical material is reduced to the level of the layman. On the other hand, the author might well be commended for the enthusiasm he brings to a subject which too frequently has only the vitality of a well-preserved herbarium specimen.

C. P. SWANSON



ECONOMIC BOTANY

THE AGRICULTURAL DEVELOPMENT OF THE MIDDLE EAST. *A Report to the Director General, Middle East Supply Centre, May, 1945.*

By B. A. Keen. His Majesty's Stationery Office, London. \$1.60. xii + 126 pp. + 15 plates + 2 maps. 1946.

The Middle East extends from Cyprus in the north to the Sudan in the south, from Persia in the east to Tripolitania in the west; it includes 14 countries with a population of perhaps 70 million. The Middle East Supply Centre was a joint Anglo-American Agency set up in 1942 to insure that the civil population in the Middle East countries was provided with those supplies which were essential for their livelihood in war-time. The author, the well-known soil physicist, spent 10 months in the field studying the agricultural problems and their closely associated educational and rural problems. He describes the characteristic agriculture country by country, and shows that the feudal system and fragmentation of holdings are serious obstacles to agricultural progress. Ten examples of new systems of agriculture now employed in the Middle East are described; important lessons can be learned from them for further planning. Possibilities of improving the existing systems of agriculture are also considered, in regard to the landowner class and the tenant and peasant proprietor. The importance of rural education and the development of rural leaders is emphasized. Scien-

tific and technical problems, particularly as concerns the soil and plant nutrition and growth, are considered in some detail, as well as crop rotation, plant improvement, seed production, plant pests and diseases, and livestock and fodder problems. Finally, the supply and development of agricultural information and advice are shown to depend both upon the training of appropriate staff and upon the establishment and staffing of a number of agricultural experiment stations. Numerous significant first-hand observations support the broad conclusions. This is a book which no one concerned with the Middle East can afford to overlook.

ROBERT L. PENDLETON



GARDENING WITH SHRUBS and Small Flowering Trees.

By Mary Deputy Lamson. M. Barrows and Company, New York. \$3.00. 295 pp. + 15 plates. 1946.

The time-consuming demands of our present day civilization often make it impossible for many lovers of beauty to maintain a garden in the ordinary sense of the word. For such persons a garden of shrubs is the logical answer. When properly chosen and planted these "friends of the busy gardener" require little care or expense and afford beauty throughout the year.

This book is a complete guide to the selection and maintenance of the proper shrubs for a great variety of purposes; and by the same token it is an excellent treatise on the art of landscape gardening. The scope of the work may be judged by the section headings: Description of Shrubs; Places to Plant Shrubs; Shrub Gardens [Roses, Evergreen, Fruit, Flower]; How to Study Shrubs; How to Select and Grow Shrubs. The text is well and interestingly written and, while it covers a wide range of subjects, the several chapters are not too lengthy.

The value of the book is greatly enhanced by twenty-six lists of carefully chosen species which are adapted for some special purpose. The lists are concerned with such matters as fall or winter color (emphasizing bark, fruit, and foliage characters), color values, foliage texture, color of flowers (arranged in order of flowering), combinations of color, and desirable species of flowering crabapples, cherries, plums, and peaches. Other headings include shrub borders at a distance, nearby borders (emphasizing fragrant species), shrubs around the house, low hedges, untrimmed hedges, and wall shrubs. A list featuring combinations of shrubs and flowers is of especial interest. In each case the list supplies the scientific name, the common name most frequently met with in nursery catalogs, and brief data regarding height, habit, proper location, color, etc. Planting plans for a lawn and for an informal green garden are included.

One section of the book is devoted to methods by

which one may become better acquainted with shrubs utilizing parks, arboreta, nurseries, the experience of friends, and nature itself. Another section is concerned with planning the grounds, the selection and ordering of the shrubs, planting and transplanting, fertilizing, pruning and watering. An adequate index of the species referred to is appended.

ALBERT F. HILL



AROUND THE GARDEN.

By Dorothy H. Jenkins; illustrated by Joseph Schulta. M. Barrows & Company, New York. \$2.50. viii + 206 pp.; ill. 1947.

Garden books are so numerous that the reading public may well wonder why new ones are written. But for *Around the Garden* such will not be the case. This little book, based on material which appeared under the same title in the pages of the New York Times from October 1943 to June 1946, has a new approach and marshalls a great variety of pertinent facts with all the competence and efficiency of an assembly line.

The author carries the reader week by week throughout a typical year, and, as the foreword states, "reminds us of our garden duties with rare good humor and tact." Not only are the necessary chores indicated in their proper sequence, but there is such a wealth of information regarding gardens and gardening, the pleasures to be derived from the work and the beauty to be seen on every hand, that the book is a veritable streamlined encyclopedia. All phases of garden activities are touched upon in their proper time and place: the choice of seeds, planting, weeding, cultivating, watering, mulching, spraying, pruning, the control of enemies and disease, suggestions for laying out gardens, and a host of other matters. Both flower and vegetable gardens are considered, and shrubs, lawns, and house plants as well. Careful perusal of this book cannot fail to help the reader, whether an amateur or a professional, attain that goal of all gardeners—a better garden.

ALBERT F. HILL



FIFTY TROPICAL FRUITS OF NASSAU.

By Kendal and Julia Morton. Text House, Coral Gables, Florida. \$3.50. 118 pp.; ill. 1946.

This finely illustrated and carefully documented book, while dealing primarily with fifty of the indigenous and exotic fruits of the Bahamas, gives much needed information in regard to tropical fruits in general and is a valuable addition to the literature of tropical agriculture. Thumb-nail sketches, written in non-technical language, present many interesting facts concerning the history, characteristics, and utilization of the fruits, and the origin and ornamental value of the plants which

produce them. Many attractive ways of preparing the fruits are included.

The fifty-five large close-up photographs, taken by the authors expressly for this work, show not only the whole fruits, but also others cut open to display their form, seeds, and flesh structure.

Unlike many popular works the scientific names are accurate and are in accord with the International Rules of Botanical Nomenclature. The common names for the most part are those used in Standardized Plant Names. Colloquial names are frequently appended.

ALBERT F. HILL



GENERAL AND SYSTEMATIC ZOOLOGY

A MULTITUDE OF LIVING THINGS.

By Lorus J. Milne and Margery J. Milne. Dodd, Mead & Company, New York. \$4.00. x + 278 pp. + 16 plates. 1947.

The matter-of-fact style in which this book is written should appeal to those who find the "poetry of life" school of nature-writing too rich for their blood. The subject-matter includes almost everything the writers could observe, nearby and on their trips, of animals ranging from garden insects to marine invertebrates, and the Milnes are, on the whole, careful recorders of their chosen world of invertebrates. Sometimes the style is almost too simple, as in the chapter on mussels, which fails to emphasize that the diverse habits mentioned are of different species (at least on the Pacific Coast), and in an inept description of the western slope of the California Sierra. Chapters based on their own observation, such as the one on the ghost crab, are excellent. Considered as a general, albeit unsystematic, introduction to the curious ways of invertebrates, this is a useful book for the amateur and general reader, and it should fulfil its avowed purpose of inspiring others to observe for themselves. The book is illustrated with some good photographs, and more would have been welcome.

JOEL W. HEDGPETH



HISTOIRES DE MER. *Les Livres de Nature. Second Edition.*

By René Legendre. Éditions Stock, Delamain et Boutelleau, Paris. 100 fr. (paper). 255 pp. 1946.

This is a collection of essays and papers, many of which have been published in journals or delivered on some occasion or another. They all concern some phase of marine biology or fisheries, falling under such headings as the marine milieu, the moon and marine life, the sanitation of oysters, belugas, lobsters, fishing among

primitive people, the metallic oxides in the sea, and a brief address on the role of marine laboratories.

This book has evidently met with some success in France, since this is the second edition.

JOEL W. HEDGPETH



ANIMAL INN: *The Stories of a Trailside Museum.*

By Virginia Moe; pictures by Milo Winter. Houghton Mifflin Company, Boston. \$2.50. xvi + 175 pp.; text ill. 1946.

Virginia Moe is the Director of the Trailside Museum of Natural History at the edge of Thatcher Woods, on the outskirts of Chicago. Here, after a pattern for Trailside Museums set by Hermon Carey Bumpus, originator of the idea, injured creatures of the wild and orphaned baby animals or birdlings are received and cared for, in as free a manner as possible. The children who live nearby may become Junior Assistants, and help with the chores, bathing the new robin's eyes with warm boric acid, gathering dandelions and clover for the wild cottontails, handling the new skunk so he will grow tamer, or getting fresh sand and bedding for the mouse's home. When the injured have recovered, they are freed; but the babes who grow up in the Museum are kept for life and soon learn to recognize their young human friends. The Director writes in a warm, simple manner of her many animal friends, from the tiniest meadow mouse to the largest of them all, a whitetail fawn named Bambi, who stayed at the Museum for a year, until he grew too large for such an establishment and had to be shipped away to a ranch in Texas. The author knows the personalities of her charges so well that she can write of them intimately without the least false humanizing of their ways or thoughts, and consequently she has written one of the best of natural histories. The woodchuck and opossum; the flying squirrels; the gray fox; the barred owls and the screech owl; the polecat, the rat, and the rabbit; turtles and salamanders; fox squirrels, gray squirrels, and red squirrels; raccoons and skunks; baby birds; and even a bullfrog—all come to life and become familiar friends or self-contained acquaintances in the author's story. She has no great knowledge of formal biology, as a few slips show; but she writes of what she has seen and lived with, day after day, and the trained biologist could do worse than to sit humbly at her feet. Of practical knowledge about how to feed little orphans and care for injured animals she also imparts a good deal. The book, of course, is written for children, but I would defyan adult biologist not to enjoy it. The drawings, too, are charming.

The conclusion, surely, is this, that we need many more Trailside Museums. Every city ought to have one.

BENTLEY GLASS

THE DATES AND EDITIONS OF CURTIS' BRITISH ENTOMOLOGY. *Smithsonian Miscellaneous Collections, Volume 107, Number 5. Publication 3894.*

By Richard E. Blackwelder. Smithsonian Institution, Washington, D. C. 25 cents (paper). ii + 27 pp. + 4 plates. 1947.

The author has given us a method by which the dates of publication of the first and second editions of various parts of Curtis' 16 volumes (each volume with 12 parts, or 770 plates in 192 parts, 1824-1839) can be established. This is of value, since in the second edition of various parts there are revisions and additions in the text of a number of parts. Since in this work many genotypes were designated, the exact date of the appearance of the revisions, changes in nomenclature, or additions is of importance in establishing the genotype under the rules of nomenclature. Fortunately, Blackwelder has a complete set of the sixteen original volumes, with the plates and text in numerical order, as well as a second set, in 8 volumes, bound in systematic order with all the reprinted pages. In addition, he examined three other sets. In this paper the author has included facsimiles of all the pages in which nomenclatural changes occur; and other changes are discussed in their systematic sequence. This should give full information as to the dates of any part (1st or 2nd editions) of this important work that the student may have before him.

ROBERT MATHESON



A REVIEW OF THE NORTH AMERICAN SPECIES OF PHILANTHUS, NORTH OF MEXICO (*Hymenoptera: Sphecidae*). *Graduate School Studies: Contributions in Zoology and Entomology, Number 7.*

By R. W. Strandtmann. The Ohio State University Press, Columbus. \$2.50. vi + 126 pp.; ill. 1946. Strandtmann has arranged keys to the males and females of some 23 species of *Philanthus* wasps (of which 2 are described as new) that he recognizes from America north of Mexico. The keys are based principally upon the character of punctuation, coloration, pubescence and, in the male, the nature of the clypeal brush. As might be expected, these keys are not always easy to use; but as the specific descriptions are detailed and clearly written, this monograph should allow certain recognition of most species in the average collection. It may be helpful to point out that couplets 29 and 37 seem to require rewriting to eliminate apparent contradiction and ambiguity in the use of the ocellar triangle as a key character. A laudable feature of Strandtmann's monograph is his stated uniform employment of 15X magnification as the microscopic working basis for his descriptions.

In *Philanthus politus* Say, Strandtmann recognizes nine forms, each designated by a trinomial and held by him to be of subspecific rank. Whether this has been

a wise course is difficult to judge, as only about 500 specimens of each sex were studied, and the true range of variation in this species seems yet to be ascertained. Indeed, a general account of the variation and geographic distribution of the American species of *Philanthus* yet remains to be drawn, as only some 5,500 specimens of *Philanthus* were studied in all. Of the 23 recognized species, 16 were represented by less than 100 specimens each, and 10 of the 16 were known to Strandtmann from 20 or fewer specimens. Four recognized species are known from one sex only, and this is also the case for three of the alleged subspecies of *Philanthus politus* Say. No doubt this reflects the rarity of many of the species in existing collections. Although the reviewer considers the geographic data inadequate for a general picture, it is unfortunate that the information collected by Strandtmann has not been brought together in the form of distributional maps, for these would give some notion of the centers of distribution, etc.

The illustrations portraying individuals of the different species and their structures are notable, being well drawn and reproduced, and serve as indispensable supplements to many of the descriptions.

As this is purely a taxonomic monograph, it contains little new material upon the biology of *Philanthus*. Nevertheless, one marvels at the venational regularity of these wasps, for Strandtmann found but a single abnormally veined wing among the 5,500 specimens. The reviewer's wonder is also awakened as to the meaning of the markedly skewed sex ratios represented in the collected material. Nine of the species significantly depart from an equality of the sexes, and of these only *Philanthus albopilosus* Cresson shows a superiority of females.

In conclusion, it may be recorded that Strandtmann has done a very considerable service to students of wasps with this painstaking and well illustrated study. It may be hoped that he will one day complete the remaining gaps in our information (is *hirticulus* the male of *bicinctus*? what is *Philanthus barbatus* Smith? etc.) and provide a rich catalog of the distributional data so important and necessary to the student of evolution.

KENNETH W. COOPER



LA VIE DES REQUINS. *Histoires Naturelles*—7.

By P. Budker. Gallimard, Paris. 325 fr. (paper). 279 pp. + 22 plates; text ill. 1947.

This is a book about sharks rather than a comprehensive treatment of the biology of the elasmobranchs. The book is on the whole descriptive, considering such matters as classification, morphology, anatomy, man-eating propensities, and economic importance. There are also chapters on freshwater sharks, remoras, and

on what might be called the folklore of sharks. As a popular treatise, written by an acknowledged authority on the elasmobranchs, this book has no counterpart in English, and it contains enough solid matter to be rewarding reading to those who must brush up on their French. An English translation for the general trade would probably be a profitable publishing venture, since almost everyone seems to be morbidly interested in sharks.

JOEL W. HEDGPETH



ENDEMIC FISH FAUNA OF LAKE WACCAMAW, NORTH CAROLINA. *Miscellaneous Publications, Museum of Zoology, University of Michigan, Number 65.*

By Carl L. Hubbs and Edward C. Raney. University of Michigan Press, Ann Arbor. 35 cents (paper). 30 pp. + 1 plate; text ill. 1946.

REVISION OF CERATICHTHYS, A GENUS OF AMERICAN CYPRINID FISHES. *Miscellaneous Publications, Museum of Zoology, University of Michigan, Number 66.*

By Carl L. Hubbs and John D. Black. University of Michigan Press, Ann Arbor. \$1.00 (paper). 56 pp. + 2 plates; text ill. 1947.

A SMALL COLLECTION OF FISHES FROM RIO GRANDE DO SUL, BRAZIL. *Miscellaneous Publications, Museum of Zoology, University of Michigan, Number 67.*

By A. Lourenço Gomes. University of Michigan Press, Ann Arbor. 50 cents (paper). 39 pp. + 3 plates + 1 table; text ill. 1947.

These papers are among the results of the careful taxonomic work being done at the University of Michigan in ichthyology, and No. 66 in particular should be of interest to those concerned with the general problems of taxonomy, as it is especially representative of the methods now in use in this field. Those who doubt that taxonomists have a sense of humor should look up the derivation of the new specific name *callarchus*, as given on p. 47 of this brochure.

JOEL W. HEDGPETH



ANIMALS OF THE WORLD: "Mammals of America"; "Mammals of Other Lands."

Edited by J. Walker McSpadden. Garden City Publishing Company, Garden City, New York. \$3.95. xx + 335 pp.; iv + 354 pp.; ill. [1917]; 1947.

Although the two books here bound as one date back some thirty years, they still present as comprehensive and well illustrated a popular treatment of the world's mammals as one can readily find in the English language. The two books are not identical in style, *Mammals of America* having a considerably fuller technical description (scientific names, dental formula, pelage,

measurements, range, food, related species and sub-species, etc.) of each animal considered than the companion volume. The latter is more characteristically the familiar "natural history." It is unfortunate that it has not been revised to correspond more closely to the *Mammals of America*.

The approximately 500 fine photographic illustrations are a striking feature of the book. Some of the plates are becoming worn, but the majority are still in good condition. The two books are separately indexed, and the index of *Mammals of America*, which consequently is at the center of the volume, is a bit difficult to locate quickly. The binding is sturdy and most attractive. The price, for these times, makes the volume a real bargain.

BENTLEY GLASS



FURRED ANIMALS OF AUSTRALIA.

By Ellis Troughton. Plates by Neville W. Cayley. Charles Scribner's Sons, New York. \$5.00. xxviii + 374 pp. + 25 plates. 1947.

The author presents an account that, while popular in style, will appeal to any naturalist who would like to become better acquainted with Australian mammals. The animals are arranged according to their evolutionary relationships and are listed under both their popular and scientific names. In addition to a brief description of taxonomic characters, the outstanding traits of behavior of each species are discussed.

In addition, almost every form is represented on color plates accompanying the text. The result is that the author presents an outstanding picture of the nature of the Australian fauna, when viewed in its entirety. A person who previously has received only superficial impressions of the nature of Australian mammals will be surprised at the extent to which evolutionary diversification has proceeded within this continent. At the same time, however, the reader will be disappointed to learn that even today the people of Australia have not been able to establish and enforce laws that are adequate to protect even classical marsupial types and that everywhere the diversity of forms noted is being reduced.

Troughton gives a great stimulus to further researches in the marsupials by noting that relatively little is known of their paleontology and that observations to date suggest as remarkable a diversification of habit as of structure throughout the many ramifications of the group.

JOHN E. CUSHING



REPORT ON CETACEA Stranded on the British Coasts from 1933 to 1937. British Museum (Natural History). Number 12.

By F. C. Fraser. The British Museum (Natural

History), London; B. Quaritch, London; Oxford University Press, London; and H. M. Stationery Office, London. 7s. 6d. (paper). 56 pp. + 7 maps; text ill. 1946.

This is the twelfth report on stranded cetacea in the British Isles. It includes accounts of 17 species represented in more than 200 strandings, with notes on size, color, dentition, and miscellaneous data. Of particular interest is the absence of the Blue, Finner, and Sei whales from this report of strandings, a possible indication of the diminution of their stock in British waters. Most of the strandings are of the common porpoise. The report concludes with a key to the British whales and dolphins.

JOEL W. HEDGPETH



HUNTING BIG GAME: An Anthology of True and Thrilling Adventures. Volume I. Africa and Asia. Volume II. The Americas.

Edited with introduction and notes by Townsend Whelen. The Military Service Publishing Company, Harrisburg, Pa. \$4.00 each; \$8.00 set. (I) viii + 339 pp. + 24 plates. (II) 282 pp. + 26 plates. 1946.

These reprinted accounts of big game hunting in Africa, Asia, and America really require no review, inasmuch as none of them is new; indeed, the majority are fifty years old or more. These good old stories recall the abundance of game in days now gone forever, and the pioneering methods and frequent risks of the early hunters whose firearms were crude by modern standards and had as yet inspired little fear among the large mammals.

The first volume contains extracts from the writings of only five authors (Selous, Baker, Kirby, Neumann, and Litledale) who have described their hunts for lions, leopards, tigers, elephants, buffaloes, and sheep. The second volume includes stories by Roosevelt, Sheldon, Selous, Stefansson, Pike, Barringer, Sears, and Whelen on their experiences with bears, caribou, musk-oxen, mountain sheep, etc. Whelen's own contribution deals chiefly with field life and some of the smaller game in Panama. Each of these authors is introduced with a brief, and rather superficial, biographical sketch and with notes on the firearms he used.

These two volumes, though well worth reading, hardly justify the title of "An Anthology." The enormous literature on big game hunting includes so many classic and glorious volumes that these all-too-few selections are pitifully inadequate, even though they contain the names of Selous, Baker, Sheldon, and Stefansson. As an anthology and guide to the best books on the subject, the volumes under review are not nearly as serviceable as *From Shikar & Safari: A Big Game Anthology*, selected by E. H. Baxter (London, 1931).

A. H. SCHULTZ

BUMPY BISON.

By Nell Smidell Nesbitt; pictures by Colista Dowling.
Binfords & Mort, Portland, Oregon. \$1.50. vi
 + 92 pp. + 7 plates. 1947.

The author of this story about the life of a bison in the days of the great Western hunts has thoroughly informed herself about her subject. The life of the bison is told with sympathy and vivid detail. It is spoiled, however, by that fatal inclination of so many writers about animals to humanize their protagonists. "Bumpy Bison," the heroine of this tale, talks and thinks about like a little girl of five or six pretending to be a bison. The worst of it is that the children like it.

BENTLEY GLASS



GENERAL ZOOLOGY LABORATORY MANUAL.

By Mary D. Rogick. The C. V. Mosby Company,
St. Louis. \$3.25 (paper). 322 pp.; ill. 1947.

This neat laboratory manual, with a plastic ring binder, is arranged for a full year course planned as an extensive survey of animal types. It is emphatically morphological rather than physiological in point of view. Heredity, embryology, and evolution are also omitted. Numerous original drawings are required of the students. The manual itself contains some excellent diagrams and drawings.

BENTLEY GLASS



ECONOMIC ZOOLOGY

GALL MIDGES OF ECONOMIC IMPORTANCE. *Volume I. Gall Midges of Root and Vegetable Crops. Volume II. Gall Midges of Fodder Crops.*

By H. F. Barnes. Crosby Lockwood & Son, London.
 (I) 12s. 6d.; (II) 15s. (I) 104 pp. + 10 plates.
 (II) 160 pp. + 4 plates. 1946.

These are the first two volumes of a proposed series of eight volumes that will deal with gall midges that attack agricultural crops. Each volume is a complete account of those midges that are known to be of importance to the crops indicated. Each volume is to be arranged on the basis of Volume I. Briefly the arrangement is as follows: a brief introduction, indicating the scope (in Volume I, in addition, a delightful account of rearing and handling gall midges), and followed by a table of contents, a list of illustrations, a list of crops (both by common and scientific names), and then the midges of each crop, arranged alphabetically by the common names of the crops. Next follow a bibliography, an index of the midges treated under generic, specific, and popular names, and a plant-index, similarly arranged. Each volume has an extended bibliography (228 titles in Volume I and 305 titles in Volume II), and in addition for each gall midge

discussed there is given its own special set of references. This is a very excellent method, for the reader does not have to search through the long bibliography to find those references which may give him more details.

The material in the present two volumes is well arranged, the accounts of the biology of the midges, the descriptions of the galls, and the effects on the host plants are written in an engaging and pleasant style and yet with scientific accuracy. They make pleasant reading not only for the entomologist, but also for the agriculturist and the layman, who will find in the volumes many accounts of these tiny creatures to arouse his interest and increase his desire to see them in the plants about him. The author does not restrict his work to our northern crops but treats crops found in all parts of the world, although the crop plants of Europe are those dealt with in detail. In most cases control measures are given.

If the present two volumes are an index of the six to follow, the author will have made a valuable contribution to our knowledge of the gall midges that attack cultivated plants. It is to be hoped the remaining volumes will appear promptly. The publishers are to be congratulated on the excellent presswork, clear and easily readable print, and the attractive bindings in green buckram with gilt lettering.

R. MATHESON



FISHERY RESOURCES OF THE UNITED STATES.

Edited by Lionel A. Walford; illustrated by Katherine Howe. Public Affairs Press, Washington, D. C.
 \$5.00. vi + 134 pp.; ill. 1947.

This is an attractively bound edition of the Report of the Fish and Wildlife Service of the United States Department of the Interior (1945), with the graphs and pictograms printed in black and blue-green. It has been reviewed in these columns previously (Q.R.B. 21: 196. 1946). In editing it for issue as a non-governmental publication, the valuable section of conclusions and recommendations for governmental action has unfortunately been omitted. (Incidentally, the name of the editor, L. A. Walford, Chief of Atlantic Fishery Investigations, U. S. Fish and Wildlife Service, did not appear upon the original publication.)

The former review of the report said, "This report will be of special interest to conservationists, ecologists, economic zoologists, and fishery people. It should also reach a much wider group; teachers of biology in colleges and secondary schools, students, and all forward-looking citizens. By making it available so cheaply the U. S. Government continues to rank foremost as a publisher of scientific material at low cost." As a sufficient comment on the last of these sentences, one may suggest a comparison of the original price (40 cents) with the \$5.00 asked by the present publisher.

BENTLEY GLASS

WATER QUALITY STUDIES OF THE DELAWARE RIVER WITH REFERENCE TO SHAD MIGRATION. *Special Scientific Report Number 38.*

By M. M. Ellis, B. A. Westfall, D. K. Meyer, and W. S. Platner. *Fish and Wildlife Service, United States Department of the Interior, Washington, D. C.* Paper; mimeographed. 56 pp. 1947.

EFFECTS OF AQUATIC WEED INFESTATION ON THE FISH AND WILD LIFE OF THE GULF STATES. *Special Scientific Report No. 39.*

By J. J. Lynch, J. E. King, T. K. Chamberlain, and Arthur L. Smith, Jr. *Fish and Wildlife Service, United States Department of the Interior, Washington, D. C.* Paper; mimeographed. ii + 71 pp. 1947.

EVALUATION OF FISHERIES IN DETERMINING BENEFITS AND LOSSES FROM ENGINEERING PROJECTS. *Special Scientific Report No. 40.*

By Richard A. Kahn and George A. Rounsefell. *Fish and Wildlife Service, United States Department of the Interior, Washington, D. C.* Paper; mimeographed. 10 pp. 1947.

DDT INVESTIGATIONS BY THE FISH AND WILDLIFE SERVICE IN 1946. *Special Scientific Report Number 41.*

By Arnold L. Nelson and Eugene W. Surber. *Fish and Wildlife Service, United States Department of the Interior, Chicago.* Paper; mimeographed. ii + 8 pp. 1947.

TOXICITY OF PHENYL-MERCURIC LACTATE FOR FISH. *Special Scientific Report Number 42.*

By M. M. Ellis. *Fish and Wildlife Service, United States Department of the Interior, Washington, D. C.* Paper; mimeographed. 6 pp. 1947.

The reports in this series are issued for limited distribution for official use of the Fish and Wildlife Service and cooperating agencies. As the titles indicate, they concern problems of immediate importance to conservation and wild life management, and often contain data of more general interest which deserve a wider distribution. This is especially true for the reports on water hyacinth and alligator weed, and on the Delaware River. The water hyacinth problem is well known to Gulf biologists, but its magnitude is probably not realized in other parts of the country. The annual loss due to it in Louisiana and Florida alone is estimated at 20 million dollars. In the Delaware River, lack of oxygen is declared to be the prime cause (induced by industrial and sewage pollution) for the decline of the fish population in that river. This touches upon the fact that many of these special reports concern problems of some political potential and tend to become obscurely buried even from the sight of specialists in the fields involved.

JOEL W. HEDGPETH



THE COMMERCIAL FISH CATCH OF CALIFORNIA FOR THE YEARS 1943 AND 1944. *Fish Bulletin Number 63.*

By the Staff of the Bureau of Marine Fisheries. *State of California Department of Natural Resources, Division of Fish and Game, Bureau of Marine Fisheries, Terminal Island.* Free upon request (paper). 81 pp. 1946.

DRIFT AND SET LINE FISHING GEAR IN CALIFORNIA. *Fish Bulletin Number 66.*

By W. L. Scofield. *State of California Department of Natural Resources, Division of Fish and Game, Bureau of Marine Fisheries, Terminal Island.* Free upon request (paper). 38 pp.; ill. 1947.

The second of these bulletins contains a full but concise description of the gear and methods of using it for fishing for sharks, rockfish and sablefish along the California coast.



OUTDOOR LIFE'S GALLERY OF NORTH AMERICAN GAME.

Prepared by the Editors of *Outdoor Life Magazine*; paintings by Francis Lee Jaques. *Outdoor Life, New York; Grosset & Dunlap, New York.* \$5.95. 142 pp. + 30 plates. 1946.

The chief game mammals and birds of North America will become more widely known and better appreciated through this attractive volume. The text is composed of brief, popular essays by various writers who deal with the natural history, as it interests the hunter, of the following birds and mammals: five different ducks, the Canada goose, turkey, pheasant, quail, grouse, woodcock, mourning dove, cottontail and jack rabbits, fox, bobcat, mountain lion, wolf, coyote, our three bears, raccoon, moose, elk, mule- and whitetail-deer, caribou, bighorn sheep, mountain goat, and pronghorn antelope. Each of these animals is pictured in a full-page, colored reproduction of a painting by Francis Lee Jaques. These illustrations, faithfully and artistically executed, are very well printed and of generous size. In addition, there are numerous delightful pen-and-ink sketches by the same artist.

A. H. SCHULTZ



ANIMAL MORPHOLOGY

AN ANALYSIS OF THE GEOMETRY OF SYMMETRY WITH ESPECIAL REFERENCE TO THE SCUTATION OF FISHES. *Bulletin of the American Museum of Natural History, Volume 88, Article 6.*

By C. M. Breder, Jr. *American Museum of Natural History, New York.* 75 cents (paper). Pp. 321-412 + 2 plates; text ill. 1947.

This study will bring to mind the classic work of D'Arcy Thompson, as it embodies the same fundamental approach to the symmetry of natural objects through

geometrical analysis. The scale patterns of several types of fishes have been analyzed in detail and compared with patterns produced by a "sine machine." The essential purpose of this study seems to be the placing of morphology on an analytical basis, and the comparison of scale patterns of fossil and recent fishes indicates "that as fishes have deepened or lengthened, in an evolutionary sense, the angles... between crossing scale rows have closed or opened accordingly, like the members of a pair of lazy tongs. . . . It is perhaps not too hopeful to anticipate a practical application of these organic grids and these distortions for a better understanding of the relationships of fishes."

JOEL W. HEDGPETH



GUIDE TO THE STUDY OF THE ANATOMY OF THE SHARK, *NECTURUS*, AND THE CAT. *Second Edition.*

By Samuel Eddy, Clarence P. Oliver, and John P. Turner. John Wiley & Sons, New York; Chapman & Hall, London. \$2.00 (paper). viii + 115 pp.; ill. 1947.

Instructors of comparative vertebrate anatomy will find the same competent and manageable laboratory manual in this second edition that they knew in the first. The material is tailored for a one-quarter term course. The directions, admirable in clarity and adequacy, are supplemented by seventeen figures, largely diagrammatic, on such topics as the circulation of the shark gill arches, the shark brain and cranial nerves, the skull of the *Necturus*, or the muscles and the various regions of the vascular system of the cat.

Only occasionally are there items to which exception might be taken. For a third edition, the authors should consider revising the treatment of the carotid arteries in the shark, as it is at present out of line with the embryological evidence and with the usage of an increasing number of comparative anatomists. One wonders also if the student's time would not be saved in the end if the major divisions of the muscular system of the shark, the epaxial, hypaxial, etc., were to be included. At least, when these authors come to the muscular system of *Necturus* and the cat, they refer back in each case to the shark.

The excellent advice that to dissect well is to separate all the parts clearly, and not to cut them up, is worded in such a way as to challenge the over-informed student to point out to the instructor that the word dissect is not derived from the word to separate or even to demonstrate but comes from a Latin verb meaning "to cut off, cut up, or to carve." Elsewhere in the manual, mammals are called "the climax of vertebrate development." Since penguins cannot read, this will probably continue to go unchallenged.

GAIRDNER MOMENT

THE DISSECTION OF THE CAT.

By Harold Madison Messer. Ziff-Davis Publishing Company, Chicago and New York. \$1.50 (paper). vi + 59 pp. + 14 plates. 1945.

This manual will provide a useful workbook for a thorough study of the anatomy of the cat by undergraduates. In the words of the author, it was written "with the specific idea of providing such complete directions for dissection and such definite descriptions of the structures that an average student could proceed with a minimum amount of help from other sources." In addition to the written directions, the book contains blank pages and partially completed diagrams for student drawings at the end of each section.

The manual is the result of years of actual laboratory experience, so that its practical effectiveness seems assured.

GAIRDNER MOMENT



AN ATLAS OF ANATOMY By Regions: Upper Limb, Abdomen, Perineum, Pelvis, Lower Limb, Vertebrae, Vertebral Column, Thorax, Head and Neck. *Second Edition.*

By J. C. Boileau Grant. The Williams & Wilkins Company, Baltimore. \$10.00. xxvi + 496 pp.; ill. 1947.

This splendid, but limited, volume could be entitled more precisely: An Anatomical Atlas of Adult White Man. It does illustrate all the gross anatomical structures of man's fully grown body in a very adequate, clear, and accurate manner. The original edition, now four years old, has already been reviewed in this journal (Q.R.B. 19: 61. 1944.) The new, second edition has been considerably revised, and enlarged by the addition of approximately 200 new illustrations. The latter refer to nearly all bodily regions. Special mention is deserved by the series of new diagrams and sketches relating to the cranial nerves and by those illustrating the epiphyses of the limb bones, as well as the additional examples of "common anomalies discovered in the dissecting room." Though the inclusion of many anatomical variations is highly laudable, the selection of the variations presented seems somewhat arbitrary, being not always influenced by the frequency of their occurrence or by their scientific significance. For instance, there have been added instructive pictures of the comparatively rare unfused acromial epiphyses and of ankylosed sacro-iliac joints, yet there is no reference to variations in the bony elements of wrist and ankle and very little regarding the common numerical variations in vertebrae or the frequent extreme variations in cranial sutures. These, however, are very minor criticisms of such a generally useful volume, with its wealth of perfect illustrations and, last but not least, its reasonable price.

A. H. SCHULTZ

COMPARATIVE BIOLOGIC-ANATOMICAL INVESTIGATIONS ON THE VERTEBRAL COLUMN AND SPINAL MUSCULATURE OF MAMMALS. *Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen, Afd. Naturkunde. Tweede Sectie, Deel XLII, Number 5.*

By E. J. Slijper. North-Holland Publishing Company, Amsterdam. 6 fl. (paper). 128 pp. + 8 tables; ill. 1946.

This important monograph deals with the postural and locomotor adaptations of the trunk in mammals. More specifically, it deals with the morphology of the vertebral column; but it is not merely a study in osteology, for the vertebral musculature and ligaments receive considerable attention, and an attempt is made to correlate their arrangements with those of the bones. This study thus is concerned with the axial portion of what the Germans have termed the "Bewegungsapparat."

The skeletons of 90 different species of mammals and the musculature of 80 different species were investigated. These species cover a wide range, including monotremes, marsupials, edentates, insectivores, bats, rodents, fissiped and pinniped carnivores, tubulidentates, ungulates, sirenians, cetaceans, and primates. These are largely treated, not in an ordinal manner, but with regard to modes of posture and locomotion—thus, quadrupedal terrestrial, bipedal terrestrial, aquatic, etc.

The detailed observations and correlations cannot be discussed here, but some final conclusions of the author may be considered. Slijper concludes that the shape and size of the vertebral bodies depend upon the static function of the body-axis to resist bending in the dorsal direction; the dimensions of the bodies are strongly influenced, however, by the development of other axial elements. Structure and development of the epaxial musculature are influenced by static factors (e.g. absolute size of body), but they depend chiefly on the type of locomotion and corresponding type of vertebral mobility. Structure, development, and inclination of the neural spines depend chiefly upon structure and development of the epaxial muscles and hence chiefly upon the type of locomotion.

Slijper's implied thesis is that form depends upon function, rather than, presumably, vice versa. This raises a venerable and still pertinent problem of prime importance to comparative anatomists—which is the cart, and which is the horse? The strongest evidence presented for the author's view is in a bipedal goat which lacked forelimbs. In this animal, the vertebral apparatus exhibited surprising approximations to features found in mammals that normally exhibit an erect posture.

WILLIAM L. STRAUS, JR.



L'ORGANISATION NERVEUSE. *Sciences d'Aujourd'hui.* By Remy Collin. Éditions Albin Michel, Paris. 150 fr. (paper). 530 pp. + 40 plates; text ill. 1944.

This volume presents an interestingly written discussion of the organization of the nervous system. While the discussion is based principally on considerations of cellular structure, data concerning the grosser physiological activities of the nervous structures are necessarily included. Roughly a third of the book (around 150 pages) is devoted to histological and cytological descriptions of nervous tissue as such, roughly 85 pages to the morphogenesis of the nervous system, roughly 85 pages to descriptions of the "nervous organs," e. g., the cord, spinal ganglia, brain-stem, supra-segmental structures, meninges, and chorioid plexuses. The final 100 pages deal with the autonomic nervous system.

The volume, which is well written, is on the whole reasonably accurate and up to date, drawing on considerable evidence derived from experiment. It is at its best at the histological level, at its weakest in the portion devoted to the "nervous organs." Considerations of fibre-tract connections are sparse and spotty; and the limitation of discussion of the thalamus to a page and a half is hardly adequate in contemporary neurology.

Since this is a book published in France, it is worthy of mention that most of the diagrams are good and that the printing, both of text and illustrations, is beautiful. This volume is recommended reading for students and others who wish to become conversant with the structure and organization of the nervous system other than at the level of fibre-tract connections.

JANE OPPENHEIMER



THE HUMAN EYE In Anatomical Transparencies.

Explanatory text by Peter C. Kronfeld; anatomical transparencies by Gladys McHugh; historical appendix by Stephen L. Polyak. Bausch & Lomb Press, Rochester. \$6.50. xiv + 99 pp. + 16 plates; text ill. 1943.

To anyone interested in the eye, this remarkable work is indispensable. It consists primarily of 34 magnificent, detailed color plates by Gladys McHugh, arranged in two series—the right eye as seen in front view, and the right eye as seen in side view. These are reproduced at twice natural size and are arranged in a unique manner, so that the reader not only is able in effect to "dissect" the eye and adjoining structures but also to reconstruct his dissection in reverse order. The value of such a translucent, three-dimensional model arranged in planes can scarcely be overemphasized. The method should find ample and grateful application in many other fields.

Accompanying this atlas is an excellent, illustrated explanatory text by Kronfeld (70 pages), and an illustrated appendix dealing with the history of concepts relating to ocular structure and function, by Polyak (23 pages).

Not the least among the many attractions of this book is the high quality of printing and paper. The price is quite moderate.

WILLIAM L. STRAUS, JR.



THE HUMAN FACE.

By John Brophy. Prentice-Hall, New York. \$3.50.
vi + 250 pp. + 23 plates. 1946.

Often penetrating and never dull is this excursion by the English writer John Brophy into a subject which seems now literature, now art, which shifts to a history of fashions in beards or hair, and sweeps now and then even over the biological substrate. How like a rueful embryologist he sounds as he says: "Just the same, it is odd and inexplicable that the hair should continue to sprout from the top of a woman's head and not from her chin. But I am very glad," he adds, "that is the way of it."

In his chapter on The Marks of Time the author is particularly good. Savor the quality of his style in this passage on middle age:

"Time marches on across the face, digging in its heels as it goes, but it cannot drag the mind and the spirit at such a headlong pace. Past the milestone of maturity, we all feel younger than we look. Vitality is a rebel within the crumbling fortifications of the body: and no man is beaten till he has lost the will to fight. I am convinced that many an old man and woman dies young, and reluctant, and surprised. . . . It would make for happiness all round if the young would occasionally remember that their seniors, behind their time-betrayed faces, feel much the same as they did ten, twenty, thirty, or even the full forty Harrovian years ago, and that the irony of misrepresentation lies in comprehensive ambush waiting for those whose only care today is that they should seem more adult than they are. But then, if the young realized that, they would be no longer young."

Yet now and again John Brophy reveals that a greater knowledge of biology might have assisted his analysis. He slips sadly in his last chapter into an acceptance of Crookshank's theory of the origin of whites from chimpanzees, negroes from gorillas, and mongoloids from orang-utangs, and so is thrust into an unnecessary spiritual conflict over racial superiorities and inferiorities. He also assumes that one's native language probably modifies the vocal organs, throat, lips, and face extensively. "The Dakota-born child with Swedish parents will have lips, tongue, palate, and vocal chords adapted by long generations of inheritance to the speaking of Swedish." It is clear that Lamarckianism is fully accepted as the basis for a concept of racial inheritance altogether unsubstantiated.

But let us forget that and allow Brophy once again

to show us "the human face, which remains a mystery; the frontal aspect of the topmost part of the body; a utilitarian collection of sense organs, a complex machine designed for seeing, hearing, tasting, eating, drinking, and speaking, which has also become the apocalyptic chronicle of all that passes in the mind, the heart and the spirit."

BENTLEY GLASS



ANIMAL GROWTH AND DEVELOPMENT

DIE HORMONVERSORGUNG DES FOETUS.

By Jules Samuels. E. J. Brill, Leiden. 17,50 guilders. viii + 320 pp. + 2 figures. 1947.

This volume is written with one purpose, but it may serve another equally well. It is intended primarily to advance the author's concept regarding the essentiality of gonadotropic hormone for cell division wherever it occurs throughout the animal kingdom. Actually, it presents a well organized and well annotated review of the sources, roles, and fates of hormones in the body throughout pregnancy. There are 544 reference citations. After a brief and more or less conventional statement of the different types of placentation occurring in mammals, there follows a detailed review of the hormone status throughout pregnancy of the anterior hypophysis, placenta, blood, and urine. Special emphasis is given to the situation in the human and the mare, although conditions in other species are considered as well. Differences in gonadotropic levels in these two species are ascribed to different fetal requirements, resulting from differences in placental structure and function.

If the foregoing statement appears novel to American investigators, it may be clarified by the following statement from the general conclusion: "The whole hormonal action during the gravidity chiefly serves the fetal growth." The author then goes on to say that the activation of cell division within the fetus, and so the increase in cell number, begins to take place by virtue of the increasing quantity of maternal hypophyseal gonadotropic hormone. Later, this function is taken over by the chorionic gonadotropins. Samuels simplifies his hypothesis by stating that this action only takes place after the thyrotropic hormone has acted, and that this is in reality identical with the hypophyseal luteinizing hormone and growth factors.

The literature on hormones in pregnancy is well summarized in this monograph. If, however, the author is regarded merely as having built a very tall house of cards with some of the ones at the bottom not set very straight, he has detracted greatly from the genuine worth which his treatise would otherwise have.

S. R. M. REYNOLDS

THE POSTNATAL DEVELOPMENT OF THE HUMAN CEREBRAL CORTEX. *Volume III: The Cortex of the Three-Month Infant.*

By J. LeRoy Conel. *Harvard University Press, Cambridge.* \$12.50. x + 166 pp. + 104 plates. 1947.

The present volume is the latest of a series of studies on the development of the human cerebral cortex, with an attempt to correlate structure and function in this region of the brain. The previous volumes were concerned with the cortex at birth (vol. I) and at 1 month (vol. II). Six brains were described in volume I, 5 in volume II, and 6 in the present volume, all similarly fixed and stained by cresyl violet, Cajal silver, Golgi-Cox, and Weigert methods.

A definitive cytoarchitectural pattern is already established at birth, with 6 layers present except in certain parts of the allocortex. The structure is strikingly similar in all parts of the cortex. The cells show no discrete Nissl substance, and neurofibrils in only the largest of the Betz cells. The cells of the precentral motor cortex (area FAy of von Economo), the Betz cells in particular, are most advanced in development. Of these, the cells related to upper trunk, shoulder girdle and brachium are furthest developed. The absence of mitoses indicates that the cortex has its full quota of neurons at birth.

There is a small, gradual increase in width throughout the cortex from birth to 3 months of age, and a corresponding development of the cells (Nissl substance, neurofibrils, length and myelination of processes). The precentral motor area remains the most advanced, particularly with respect to the cells related to the shoulder and upper arm, although those related to the hand develop rapidly. Development in other lobes of the cortex follows the frontal lobe in the following order: (1) parietal, (2) occipital, (3) temporal, and (4) gyrus cinguli and rhinencephalon. In the first three of these, the primary receptive areas for somatic sensibility, vision, and hearing are more developed than other parts of the lobes. In the premotor area of the frontal lobe, the region dealing with contralateral deviation of the eyes is most advanced. It is interesting to note that electrical potentials can be recorded at 1 month from only the precentral gyrus.

At 3 months, Nissl bodies are found in the largest Betz cells, and there is a great increase of the fibers of layer IV in the precentral motor and the primary receptive areas. Tests of behavior at 3 months are closely correlated with anatomical development, in indicating slight purposeful movements of the shoulder and arm, but not of the head, hand, or lower extremity. Slight cortical visual and acoustic functions are possible. Any cortical function appears to involve chiefly layers V and VI, possibly III and IV, but not I and II.

The author is to be congratulated on a thorough and useful series of studies. The text is carefully written and unwarranted speculation has been avoided. The

plates are excellent. Enlarged drawings showing the development of the Nissl substance would help, however, in the understanding of this process. The price of the present volume (\$12.50) seems rather excessive, even when one takes into account recent increases in printing costs, since the first two volumes were priced at \$8.00 each.

WILLIAM L. STRAUS, JR.



ANIMAL PHYSIOLOGY

THE CHEMICAL SENSES.

By R. W. Moncrieff. *Leonard Hill, London.* 25s. viii + 424 pp. 1944.

There has long been a need for a book in the English language which would treat all the chemical senses as Henning's *Der Geruch* did for the olfactory sense. Moncrieff's comprehensive and detailed treatise is a notable step in this direction. Accumulated and assimilated here is a wealth of heretofore scattered information.

The subject matter, well integrated, falls into three broad categories: the biological (Chapters 1-5, 7), the chemical (Chapters 6, 8-12), and the applied (Chapters 13 and 14). The chemical sections are by far the most well done. Contained therein are outlines of the various proposed classifications of odors, an excellent exhaustive and well documented treatment of the relations between chemical constitution and odor and taste, and the physical properties of odors. The numerous theories of odor are concisely and critically presented.

Unfortunately the biological sections are less satisfactory. They discuss the structure and innervation of chemoreceptors, sensation, the phylogeny of chemical sensitivity, and such physiological aspects as adequate stimuli, fatigue, acuity, anosmia. One searches in vain, however, for much of the better recent physiological work. In the case of insects, for example, only a single paper of von Frisch's is mentioned, and no reference is to be found to Minnich's outstanding work on tarsal receptors.

A tremendous amount of work has undoubtedly gone into assembling the facts for this book. It is of inestimable bibliographic value. One of its great services is that of illustrating how little we really know about the chemical senses and how hundreds of apparently unrelated experimental facts await assimilation. The fact that the bulk of our information deals with sensation from man's point of view rather than with stimulation treated objectively merely reflects the trend of experimental endeavor in this field.

In places the presentation is "popular" to an extreme, and some of the analogies appear oversimplified, as, for example, the expansion of the analogy of stereoisomerism with right-handedness. It is regrettable that more care was not expended on the illustrations, most

of which are crude. Among minor points for criticism are the occasional capitalization of specific names and the use of lower case initials for generic names. The glossary suffers from defects comparable to those in the figures, to wit, oversimplification. Definitions of chemical terms are superior to the biological, e.g., tropism—habit of going to or away from a stimulus.

All things considered, however, Moncrieff has made a commendable contribution in a field which is admittedly very difficult. Even in the face of having to accept such punishment as "...hydrogen sulphide, a very bad egg olfactorily," readers interested in sensory physiology and physiological psychology will find this volume invaluable.

V. G. DETHIER



COMPARATIVE STUDIES IN THE LIGHT SENSITIVITY OF BLIND CHARACINS FROM A SERIES OF MEXICAN CAVES. *Bulletin of the American Museum of Natural History, Volume 89: Article 5.*

By C. M. Breder, Jr. and Priscilla Rasquin. *American Museum of Natural History, New York.* 40 cents (paper). Pp. 319-352; ill. 1947.

These experiments on the reactions of related fish from a series of caves indicate a progressive sensitivity to light from the initial river form to that of the most distant cave. On the basis of these results, together with genetic and morphologic data, the authors conclude that the populations involved worked up the now dry valley underground, and did not sink into the ground from former local surface populations in the vicinity of the caves. The picture is thus one of divergence rather than of the development of parallel but independent populations.

JOEL W. HEDGPETH



PATTERNS OF MAMMALIAN REPRODUCTION.

By S. A. Asdell. *Comstock Publishing Company, Ithaca, New York.* \$5.00. xiv + 437 pp. + 12 plates. 1946.

This book is a significant attempt to present the many variations of reproductive physiology in mammals and to draw a general outline of mammalian reproduction based upon this extensive collection of material. Approximately 200 species, representing the major taxonomic groups, are treated in greater or lesser detail, while the inclusion in tables of forms less well known brings the number of species treated to over 900. The author has examined literature usually ignored by the physiologist, who tends to confine himself to a comparatively short list of journals. The success of the author in digging out the facts he sought from field reports shows the thoroughness with which he has attacked the problem.

An introduction of 30 pages covers a wide variety of sub-heads and forms a background for original observations based on the material that follows. This is the most readable part of the book and is also the most stimulating. The remainder is more for reference. One might object to the difference in length of the various accounts, but this it was impossible to avoid, for very little material is available on most species not usually used in the laboratory or found on the farm. The accounts are arranged in taxonomic order. Physiologists may disagree, but this arrangement seems most useful to other zoologists.

There are a few errors in the book, such as misspelling the name of an author. The book is a good example of the printers' and bookbinder's art. This is commendable, for students and research workers will give it hard use, as the standard reference work in its field.

ROBERT K. ENDERS



DIE HORMONALEN ASPEKTE DES FORTPFLANZUNGSPROZESSES.

By Jules Samuels. *Holdert & Company, N.V., Amsterdam, Holland.* \$5.80. vi + 152 pp. 1946. The fundamental theme of this small book is that reproductive processes, wherever they occur, have one thing in common: gonadotropic hormone activates the process of cell and egg-cell division. The presumptive biological basis of this is discussed at length throughout the three chapters of the book. After citing numerous examples of the necessity of the hypophysis for an egg cell to undergo meiosis and other situations in which there is clearly a relationship between the hypophyseal hormone and the elaboration or maturation of certain tissues, the author proceeds to attribute parthenogenesis, the mitosis of somatic cells, and the like to the "division hormone" contained within the cells.

Samuels has amassed considerable data from the literature (217 references cited) which bear on the relation of hormones to cellular proliferation throughout the animal kingdom. For this, the reader will find this book a convenient monograph. But it will be difficult for the critical reader to follow the arguments which the author brings forth in support of his thesis.

S. R. M. REYNOLDS



PHYSIOLOGY OF MAN IN THE DESERT. *Monographs in the Physiological Sciences.*

By E. F. Adolph and associates. *Interscience Publishers, New York and London.* \$6.50. xiv + 357 pp.; ill. 1947.

This volume is in essence the summary of a collaborative research effort carried out by E. F. Adolph and ten associates during the war. It was supported by and

for the use of the Committee on Medical Research, of OSRD. The work was carried out for the purpose of procuring as quickly as possible some practical results which would be applicable to the conduct of war activities in the desert. The results set forth here attest admirably the success of this effort.

In reality, however, this work is but a small part of the broader, important subject of what has come to be called "environmental physiology."² It is a type of investigation that is attracting an increasing number of physiologists, who are working in desert, arctic, and jungle climates as well as at different altitudes. Physiological studies have been carried out in the past under these conditions, but seldom have they covered the range of subjects or included the number of participating individuals which played a role in this book. Even so, it is not claimed that this is an exhaustive treatise on the subject.

In general, this volume considers the problem of the regulation of body temperatures in the desert, in particular, the question of heat exchanges, sweat formation, and water turnover. After a general orientation of the subject, it is elaborated, chapter by chapter, as the story was unfolded by studies conducted for the most part in the desert of southern California, but also in a "desert" laboratory at the University of Rochester upon men on rafts, and upon men at flight altitudes as well. Basic data are offered on rates of sweating, heat exchanges, urinary excretion rates, and fluid intake in the desert. The question of water requirements in the desert, and of water shortages and blood changes in dehydration are likewise reported. Limited observations on the circulation and temperatures of men dehydrating in heat are reported. Data and observations on the signs and symptoms of dehydration in the desert, thirst, and voluntary dehydration are presented.

The text is well supplied with climatological maps, graphs, and appendices containing additional data. Because of these facts, this volume will be of great value to physiologists in general and particularly to those engaged in studies of environmental physiology in connection with industry or the armed services.

However, the physiologist will miss in this book considerations of some of the general, basic implications of homeostatic mechanisms that operate in the organism as a whole. Again, the critical reader will wish that the data were such that the limits of tolerable stress and the physiological conditions affecting these limits might be given. For example, how exact is the figure of 20 per cent, quoted as the limit of irreversible dehydration in the human body? Will some men be much more tolerant than others? What are the functional adaptations involved in acclimatization to conditions in the desert, and how do individuals of different ages, somatypes, and previous clinical histories react? In short, the important factors of individual variation remain largely to be established upon the excellent basic groundwork laid by this work.

One of the striking findings of this work is the interesting—and important—observation that men in the desert lose less water by sweating when clothed than when unclothed. Thus the experience of desert nomads for ages past finds here a physiological affirmation of what experience must have taught. In fact, one who has read *Seven Pillars of Wisdom* has but to recall the conduct of Lawrence of Arabia and his colleagues in their long night journeys and their attention to clothing and shelter during the daytime to comprehend what experience has taught the nomads and warriors of the desert. One must wonder, as he views the scene of current history, how much such wisdom will work for or against the divided forces that are again drawing their lines in the deserts of the Near East.

S. R. M. REYNOLDS



LA RÉGULATION HORMONALE DU MÉTABOLISME ET LA VITAMINE A.

By Michel de Visscher; preface by Léon Binet and J. P. Bouckaert. *Les Éditions de Visscher, Bruxelles; Masson & Cie., Paris.* 250 fr. (paper). 192 pp.; text ill. 1946.

Based on an analysis of the hyperthyroid syndrome, the author advances two theses: (1) that there exists a relationship between the sympathoadrenalin system and the thyroid hormone; (2) that vitamin A modifies this relationship. From experimental work on the basal metabolic rate of rabbits studied in a differential calorimeter and receiving various treatments, the following conclusions were derived: (a) adrenalin in physiological doses stimulates heat production; (b) this effect disappears in the thyroidectomized animal but reappears on administration of thyroid hormone; (c) these interactions occur at the tissue level, thyroid hormone sensitizing the tissues to adrenalin; (d) vitamin A causes a very slight lowering of the normal basal metabolic rate, but not of the hyperthyroid rate; (e) vitamin A prevents completely the metabolic action of adrenalin. Although the experimental section occupies a hundred pages, the total number of animals used to demonstrate at least some of these important conclusions appears to have been small, and occasionally obscure. Single protocols are sometimes given and little inkling of the normal variation to be expected, and actually encountered, can be obtained. The theoretical structure of the essay, consequently, tends to reflect back rather to the authority of the writer than to compelling experimental proof, here presented.

H. R. CATCHPOLE



PRÉCIS DE PHYSIOLOGIE.

By L.-C. Soula. *Masson et Cie., Paris.* 1450 fr. vi + 1085 pp.; ill. 1947.

This is an outline of physiology by the professor of this discipline on the Faculty of Medicine at Toulouse. It is written, therefore, with the point of view of a teacher, —and quite clearly of an experienced teacher. The organization of the book differs from conventional American and English texts in a number of respects. For example, instead of commencing with functional aspects of cells, especially nerve axones, and proceeding from the specific to the general, Soula commences with a consideration of the general functions of nutrition of the mammalian organism. This encompasses oxygen and nutritive requirements; digestion and absorption; followed by circulatory and respiratory mechanisms as supporting mechanisms for the former. The blood and homeostasis, and intermediary metabolism are discussed in relation to energy production and to growth. The second part of the book then deals with the functions of the integrative mechanisms of the body. These include the relation of muscle physiology, nerve muscle physiology, and the central and sympathetic nervous systems to the functioning of the body as a whole. The rationale of this organization is fully justified by the logical development and exposition of an admittedly large and complex subject.

This treatment of the subject imposes of necessity several limitations which American readers will notice at once; yet they are clearly justified by the logic of the organization. The subject of the ductless glands is not taken up in any one place, but is treated throughout the numerous parts of physiology to which this subject is related. Thus the thyroid and adrenal glands are discussed in relation to energy production, the pancreas in relation to carbohydrate metabolism, the gonads, parathyroids, and so forth to morphogenetic development.

If the treatment of many topics is superficial, as indeed it is, this is more than made up by the scope of this book, and the logical development of the subject as a whole.

The volume is dedicated to the late Professor Sherrington.

S. R. M. REYNOLDS



ANIMAL NUTRITION

ANIMAL NUTRITION. *McGraw-Hill Publications in the Agricultural Sciences. Second Edition.*

By Leonard A. Maynard. *McGraw-Hill Book Company, New York and London.* \$5.00. xviii + 494 pp.; ill. 1947.

The author is an outstanding investigator and teacher in the field of animal nutrition, and his knowledge and experience are reflected throughout this excellent textbook for students of agriculture. The objective was to present the principles of nutrition and their applications in feeding practice. The subject is presented from the

biochemical standpoint, and basic principles are discussed clearly. Nine years have elapsed since the appearance of the first edition. The author has now incorporated, with great economy of words, a large amount of new material based upon the researches of recent years. The book can be highly recommended as a student textbook and for farmers who have taken a degree in agriculture.

E. V. MCCOLLUM



CALCIUM AND PHOSPHORUS IN FOODS AND NUTRITION.

By Henry C. Sherman. *Columbia University Press, New York.* \$2.75. x + 176 pp. + 1 plate. 1947.

Calcium and phosphorus overshadow all other inorganic elements of physiological significance in the amounts which occur in the body. It is therefore appropriate to discuss these elements apart from other essential nutrients in their various biochemical functions. The titles of the seven chapters in the present book are: Background of the calcium and phosphorus problems in nutrition; Calcium in the body; Effects of food and growth upon the calcium content of the body; Chemical forms and nutritional functions of phosphorus in the body; Calcium and phosphorus requirements; The problems of the necessary and optimal intakes; Foods as factors in the nutritional provision of calcium and phosphorus; and Summary and suggestions. There is a selected bibliography, and an Index. In 115 pages the author has presented a digest of data and interpretations derived from the bibliography of about 500 journal references. The book will serve admirably the needs of teachers of nutrition and physiology, and as a handy reference to publications describing the principal researches relating to calcium and phosphorus in physiological processes. A knowledge of biochemistry and physiology will be necessary for an appreciation of the book.

E. V. MCCOLLUM



STUDIES ON THE NATURE OF THE BROMATE EFFECT.

By Holger Jørgensen. Einar Munksgaard, Copenhagen; Humphrey Milford, Oxford University Press, London. 40s. or 40 Dan. cr. 435 pp.; ill. 1945.

The author is chief of the research department of the Dansk Gaerings-Industri, Ltd. of Copenhagen. The present English translation of the original Danish edition presents, in its earlier chapters, an excellent discussion of baking strength in flour as affected by various additions to the dough. The greater part of the book is devoted to descriptions of the experimental methods of studies in which numerous substances were added in small amounts to dough, and of the results obtained. The objective of the studies was to discover

the nature of the remarkable bromate effect so highly valued by bakers everywhere. The book is a scholarly work and should be read by every chemist who desires to know about the chemistry of flour and of baking processes. It is the best work available on the subject, as far as the present reviewer is aware.

E. V. McCOLLUM



BIOCHEMISTRY

DYNAMIC ASPECTS OF BIOCHEMISTRY.

By Ernest Baldwin. Cambridge, at the University Press; Macmillan Company, New York. \$4.00. xvi + 422 pp. 1946.

Biochemistry is the science which deals with the chemical processes occurring in living organisms and in interpreting aspects of biological function in chemical terms. In spite of the remarkable achievements of biochemistry, this broad aspect of the science has been obscured by our university courses, textbooks, and journals, which have been primarily concerned with clinical chemistry. Perhaps the current interest in microbiology, biochemical genetics, and cytochemistry may serve to bring recognition to general biochemistry as an academic discipline.

The development of general biochemistry will be greatly aided by a useful and readable book dealing with the chemical processes in cells and their mediation by enzymatic systems. Baldwin has now written such a book, and his title is well chosen. He is careful to distinguish between the organic chemistry of naturally occurring compounds, as the necessary foundation of biochemistry, and the dynamic changes which these compounds undergo within living organisms, and the biological consequences of these reactions. This latter, or dynamic aspect, is the one Baldwin emphasizes as the real subject matter of biochemistry.

This book should be of value not only to students studying biochemistry, but to all graduate students in biology and to many in chemistry. In fact, many mature biologists will spend a profitable and pleasurable evening with this book. The technical knowledge required for its reading is slight. The number of specific literature references is few, and yet the examples chosen to illustrate the points made are fairly widely selected from the fields of biology. Although Baldwin states that he wrote the book as a textbook for students studying non-medical biochemistry, he commands a lightness of style and a verve not found in the usual textbook.

Part I deals with enzymes and the nature of the catalytic process, and has chapters on hydrolytic, phosphorylytic, and oxidizing enzymes. Part II contains 11 chapters that deal with metabolism. The treatment is straightforward, easily comprehended, and written with an advanced student in mind as

reader. On the whole, it is modern, but conventional. The treatment of catalysis is classical, the kinetic treatment essentially non-mathematical, and perhaps both too conventional and too simple.

The reviewer would have liked to see a much fuller treatment of nucleoproteins and their role in chromosomes, viruses, etc., and more attention given to cytochemistry and to chemical changes in relation to growth and differentiation. Plant biochemistry is largely omitted from this volume; and photosynthesis, one of the most intriguing of all biochemical reactions, is entirely omitted, as is nitrogen fixation also. Although this book consequently fails to fill the need for a truly general biochemistry, it deserves to be successful, and is definitely oriented in the right direction. Biochemistry has not yet found its Bayliss, just as physiology seems unable to produce a second one.

DAVID R. GODDARD



CURRENTS IN BIOCHEMICAL RESEARCH: *Thirty-one essays charting the present course of Biochemical Research and considering the intimate relationship of biochemistry to medicine, agriculture and social problems.*

Edited by David E. Green. Interscience Publishers, New York. \$5.00. viii + 486 pp. 1946.

The primary purpose of the volume, according to the editor's preface, is to provide a perspective which could assist biochemists, as well as non-biochemists, to arrive at a proper estimation of the relation of biochemistry to other fields of investigation. It is also proposed to provide for research workers the opportunity "to describe in as simple a language as possible the important developments in their own fields and to speculate a little on the most likely paths of future progress."

The volume consists of 31 essays ranging from The Gene and Biochemistry (G. W. Beadle) to Social Aspects of Nutrition (W. H. Sebrell). It therefore covers a wide variety of subjects and viewpoints. There are, however, a few surprising omissions. For example, the recent advances in our knowledge of polysaccharide synthesis, with its broad implications for biological synthesis in general, is hardly discussed adequately. The spectacular advances in the bacterial viruses of the last few years are only mentioned in passing.

Biologists should read this book not alone for the wealth of factual material contained in it. More important perhaps is the insight into the attitudes and methodology of their biochemical colleagues in the analysis of common problems.

It is inevitable that the present volume should be compared with the earlier *Perspectives in Biochemistry*, which had a similar purpose. On the whole it must be admitted that *Currents in Biochemical Research* suffers

by the comparison. It fails to arrive at the levels of excitement attained by the authors of the previous volume. For the most part, the present essayists have failed to take the opportunity provided by the editor "to speculate a little"; or if they did, they took his invitation for a warning.

In view of some of the omissions, it is difficult to avoid noticing the peculiar geographical distribution of the essayists. One is tempted to rename the book to "Currents in Biochemistry in and around New York."

S. SPIEGELMAN



ANNUAL REVIEW OF BIOCHEMISTRY. Volume XVI.

Edited by J. Murray Luck, Hubert S. Loring, and Gordon Mackinney. Annual Reviews, Stanford University P. O., California. \$6.00. xii + 740 pp. 1947.

The task of reviewing a group of reviews such as this always brings one face to face with the limitations of the individual in this age of specialization. This is the fact that one can only develop experience, understanding, and a vocabulary, in one, or at the most a few, of the special fields. It is the recognition of this fact that has stimulated annual reviews such as this. They are reviews written by experts in a field, to be read by others specializing in related and other fields. While the chapter headings change little from year to year, the reviews are protected from monotony and redundancy by a system of changing reviewers each year. Thus there is opportunity for placing emphasis on that part of the field in which the reviewer is interested and to which he has contributed. As a result, the chapter on any given subject one year may not be concerned with the same group of substances that were discussed in the chapters with similar titles in previous years. Biologists will do well to form a habit of browsing through these authoritative reviews each year to keep in touch with advances in their own and related fields.

The first chapter, by Michaelis, is an excellent example of the above statements. In this chapter the major advances made in the field of biological oxidations and reductions during the preceding year have been discussed. At times, one receives the impression that the review is little more than an annotated bibliography, but in the numerous places which coincide with the author's own interests there is displayed the unmistakable stamp of an authority who has contributed to the basic problems of this field. This requires, in addition to the ability to evaluate critically the advances, pointing up the unsolved problems.

It would be presumptuous of a reviewer to be critical in a specific way of most of the reviews in this series. It would also be futile and require too much space to attempt to give a summary of all the chapters and

subjects covered. This review will therefore be limited to a mere mention of some of the chapters and some discussion of the content of chapters that appear to be timely and of special interest to biologists. This year's volume contains 25 reviews which average 26 pages each. The author index lists approximately 4300 names, and the subject index, which fills 23 pages, lists over 2500 items.

As in previous years, there are chapters on proteolytic enzymes, carbohydrates, lipids, phosphorus compounds, carbohydrate metabolism, and the metabolism of proteins and amino acids. In the chapter on fat soluble vitamins, Embree has summarized the recent work on the synthesis of vitamin A or compounds resembling vitamin A and has discussed the biological activity of these compounds. The chapter on water-soluble vitamins by Woolley discusses the broad fundamental advances made in 1946. Of these, the elucidation of the structure of folic acid and the use of this substance in the treatment of pernicious and other anemias appear to have been the most outstanding. Another very significant discovery was that the proteins in the time-honored "vitamin free casein" contain an essential nutritive factor which is not an amino acid, and hence supply more than the essential amino acids in experimental diets. The chapter on animal pigments in this volume concerns itself with a discussion of carotenoid and indolic biochromes. The reviews on the nitrogenous constituents of plants and the mineral nutrition of plants may be of interest to those in the botanical specialties. The relatively long and comprehensive review of growth substances in higher plants, by Skoog, will provide much food for thought, not only for botanists but also for those interested in problems of growth in general.

The chapter which is most timely and which will undoubtedly prove to be of great current interest to biologists is the one on the fundamental aspects of the use of isotopes in biochemical research. In 21 pages Kamen has presented the basic considerations and, what is just as important, some of the limitations of the use of isotopic tracer techniques. While this chapter cannot compare with the more recently published book on this subject by the same author, it is a masterly presentation of the subject.

FRANK H. J. FIGGE



APERÇUS SUR LES PROGRÈS DE LA BIOCHIMIE, DANS LES PAYS ANGLO-SAXONS, DEPUIS 1940.

Actualités Biochimiques, Number 1.

By Marcel Florin. Éditions Desoer, Liege; Masson et Cie., Paris. 200 fr. (paper). 77 pp. 1945.

DONNÉES RÉCENTES SUR LA NATURE ET LE MÉTABOLISME DE L'OS. *Actualités Biochimiques, Number 2.*

By Marcel J. Dallemagne. Éditions Desoer, Liege;

Masson et Cie., Paris. 200 fr. (paper). 68 pp. 1945.

L'ÉVOLUTION DU MÉTABOLISME DES SUBSTANCES AZOTÉES CHEZ LES ANIMAUX. *Actualités Biochimiques*, Number 3.

By Marcel Florkin. *Éditions Desoer, Liege; Masson et Cie., Paris*. 200 fr. (paper). 66 pp. 1945. MÉTHODES NOUVELLES D'ANALYSE BIOCHIMIQUE ET CLINIQUE (1^{re} série). *Actualités Biochimiques*, Number 4.

By Ghislaine Duchateau. *Éditions Desoer, Liege; Masson et Cie., Paris*. 140 fr. (paper). 63 pp. 1946.

DONNÉES RÉCENTES SUR LA COAGULATION DU SANG. *Actualités Biochimiques*, Number 5.

By Pierre Fredericq. *Éditions Desoer, Liege; Masson et Cie., Paris*. 140 fr. (paper). 63 pp. 1946. ACQUISITIONS RÉCENTES DANS LE DOMAINE DE L'ENZYMLOGIE. *Actualités Biochimiques*, Number 6.

By L. Massart. *Éditions Desoer, Liege; Masson et Cie., Paris*. 140 fr. (paper). 62 pp. 1946. CONCEPTION ACTUELLE DU CATABOLISME DE L'HÉMOGLOBINE. *Actualités Biochimiques*, Number 7.

By Claude Liébecq. *Éditions Desoer, Liege; Masson et Cie., Paris*. 140 fr. (paper). 64 pp. 1946. These seven pamphlets are the initial numbers in a series of reviews published under the direction of Marcel Florkin, and are intended to provide a summary of current progress and trends in special aspects of biochemistry and physiology. There is much to be said for the publication of reviews in this form, rather than as collections in journals or bound volumes. It is inexpensive, and any worker can secure just those reviews of most interest to him. On the other hand, it may lead to a narrowing of interest that in time would be unfortunate. Yet the advantages seem to outweigh the disadvantages, and the plan may be recommended to the consideration of American editors and publishers, who seem bent on bringing out every year more and more expensive volumes of reviews.

BENTLEY GLASS



COLLOIDS: *Their Properties and Applications*. Blackie's "Technique" Series.

By A. G. Ward. *Interscience Publishers, New York*. \$1.75. x + 133 pp. + 6 plates. 1946.

This is a simple book, but nevertheless an effective one. As a non-specialist in the field the reviewer felt, as he turned the pages, that the author had firmly taken him by the hand and was giving him a personally conducted tour of the world of colloids. This world is a large one and, as the author points out, an important one, for not only are colloids of fundamental importance in many technological processes, but they are also basic in the functioning of living organisms. It is

indeed surprising how much valuable information can be presented in 130 small, printed pages. Many important things have been left out and no subject is treated in detail, but this always needs to be true of a book of this sort.

The cover bears the words: "A simple account of the physics and chemistry of colloids, with their many applications in physics, engineering, geology, biology." The author has clearly accomplished what he set out to do.

I. FANKUCHEN



VITAMINS AND HORMONES. *Advance in Research and Applications*. Volume IV.

Edited by Robert S. Harris and Kenneth V. Thimann. *Academic Press, New York*. \$6.80. xviii + 406 pp. 1946.

H. A. Schneider has contributed to this volume a model review in a difficult field—the "strategic situation" in nutrition and resistance to infection—with some pertinent remarks on the nature of reviews themselves. Clements's article on nutritional deficiency in infants nicely supplements Warkany's account last year of the prenatal deficiencies. Thayer covers the field of the bioassay of animal hormones in a generally useful article. Reviews may suffer from over-topicality, in a subject where advances are rapid, and this seems to be the case with the hematopoietic factors (Pffiffer and Hogan). Until chemically defined substances emerge from the welter of such factors of the B-complex (a process that seems to have started with the isolation of pteroylglutamic acid), the general reader may well feel stranded in a terminological jungle. Conclusions reached by Houssay (the thyroid and diabetes) and Hertz (effect of B-vitamins on reproduction) are largely tentative.

Other contents: Nutritional therapy of endocrine disturbances (Biskind); Thyroactive iodinated proteins (Reinke); The protein anabolic effects of steroid hormones (Kochakian).

This volume maintains the high standards previously set by the editors.

H. R. CATCHPOLE



CHEMISTRY AND PHYSIOLOGY OF THE VITAMINS. *Revised reprint*.

By H. R. Rosenberg. *Interscience Publishers, New York*. \$7.50. xiv + 676 pp. 1945.



RECENT PROGRESS IN HORMONE RESEARCH. *Proceedings of the Laurentian Hormone Conference*. Volume I.

Edited by Gregory Pincus. Academic Press, New York. \$7.50. vi + 399 pp.; text ill. 1947.

This book is a handsomely produced record of papers given at the Laurentian Hormone Conference in the late summer of 1945. It is the first volume of an annual series and comes with a roster of distinguished contributors. One's natural welcome to a new periodical may be tempered by such questions, (among others) as: Does it specifically contribute a fresh medium not elsewhere available for the dissemination of new scientific knowledge or new syntheses of such knowledge? Does it command international coverage in respect of contributors? As regards the first, there is already in the field *Vitamins and Hormones*, with which the subject matter of the present volume partly overlaps. On the other hand, Volume I of *Recent Progress in Hormone Research* includes articles ranging from pure chemistry to experimental pathology. With regard to the second question raised, the make-up of a regional conference may work against an international participation except within this (northern) hemisphere; however, 1945 was an abnormal year, and it is possible that this situation may already have changed in the direction of a more general representation of the field of hormone research.

The contents are as follows: Neurohumoral relationships: On the role of acetylcholine in the mechanism of nerve activity (Nachmanson); Hormones and mating in behavior (Beach).

Chemistry and physiology of adrenal hormones: Steroids derived from the bile acids (Kendall); Some advances in the partial synthesis of adrenal cortical steroids (Gallagher); The relationship of cholesterol and ascorbic acid to the secretion of the adrenal cortex (Long); Studies of the role of the adrenal cortex in the stress of human subjects (Pincus).

The role of hormones in metabolic processes: The relation of the anterior pituitary hormones to nutrition (Samuels); The role of hydrolytic enzymes in some of the metabolic activities of steroid hormones (Kochakian); Studies on steroid hormones in experimental carcinogenesis (Gardner).

Aspects of clinical endocrinology: Endocrine aspects of human cancer (Nathanson); The effects of hormones on osteogenesis in man (Albright); Certain factors which influence the rate of growth and the duration of growth of children (Talbot and Sobel); Experimental renal hypertension with special reference to its endocrine aspects (Grollman).

H. R. CATCHPOLE



CHEMISTRY OF MUSCULAR CONTRACTION.

By A. Szent-Györgyi. Academic Press, New York. \$4.50. viii + 150 pp.; ill. 1947.

The present book represents an outgrowth of the

Cameron Prize Lecture which Szent-Györgyi gave at Edinburgh in 1946. It is an unusual and stimulating presentation on the chemistry of muscle contraction. It covers primarily the previously unpublished observations which were made during the war years by the author and his colleagues. The new and in many cases quite speculative ideas about muscle contraction will obviously stimulate a great deal of experimentation.

The book is divided into five parts, of which the first is concerned with Myosin, Actin, and Actomyosin and the second with the Conditions and Reactions in Muscle. Part IV presents the advancements in the period 1946-47 and qualifies and re-emphasizes certain of the viewpoints presented in the earlier two sections.

In Part III the author presents his Continuum Theory, a highly interesting but speculative idea concerning band spectra in protein complexes. This theory is concerned primarily with the pooling of valency electrons in complexes of molecules to form a sort of continuum along which the electrons may travel. In this case the valency electrons become the property of the whole system rather than that of a single atom. The experimental support for such a theory comes primarily from observations on the phosphorescence of gelatin phosphors.

Part V is concerned with methods and is probably the most important section for the research worker. In this part the author describes the methods employed in his laboratory for the preparation of adenosine triphosphate in large quantities, and for the isolation of myosin, actin, and actomyosin threads.

Szent-Györgyi's book will certainly be received enthusiastically by all those interested in the physiology of muscle contraction and related subjects.

W. D. McELROY



SURVEY OF CONTEMPORARY KNOWLEDGE OF BIOGEOCHEMISTRY. 1. *Isotopic Phenomena in Biogeochemistry. Bulletin of the American Museum of Natural History, Volume 87, Article 2.*

By Martin D. Kamen. American Museum of Natural History, New York. 35 cents (paper). Pp. 101-138; 3 figs. 1946.

"All of the available evidence on isotope effects in the biosphere is (here) collected and discussed. . . . There is a paucity of reliable data on geochemical isotopes. . . . The special role of biological systems in affecting isotope separations still remains to be established. Preliminary data already reveal such effects for hydrogen, oxygen, and carbon, and perhaps potassium."



BIBLIOGRAPHY OF REFERENCES TO THE LITERATURE ON THE MINOR ELEMENTS AND THEIR RELATION TO

PLANT AND ANIMAL NUTRITION. *Seventh Supplement to the Third Edition.*

Compiled and published by the Chilean Nitrate Educational Bureau, New York. Free upon request. (paper). 121 pp. 1947.

Abstracts, author and subject indices.

REPORTS OF THE BIOCHEMICAL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE. *Volume VIII, 1944-1945. With an Index to BRF Publications Nos. 1 to 212 and BRF Notes November 1938 to December 1945.*

Collected Papers. *Biochemical Research Foundation, Newark, Delaware.* \$3.00. [1947].



MICROBIOLOGY

AN INTRODUCTION TO BACTERIOLOGICAL CHEMISTRY. *Second Edition.*

By C. G. Anderson. *A William Wood Book; The Williams & Wilkins Company, Baltimore.* \$5.00. x + 500 pp. + 1 chart; text ill. 1946.

The second edition of this textbook has been enlarged by the addition of two new chapters dealing with chemotherapy and antibiotics, as well as by sundry insertions elsewhere. It still remains a poor piece of work, confused, out of date, and replete with factual errors. The confusion is well illustrated by the treatment accorded to those respiratory processes employing extraneous hydrogen acceptors other than free oxygen. Of the three most important examples, carbonate reduction (methane formation) is handled along with the totally different process of methane oxidation in the chapter on autotrophic nutrition, nitrate reduction is mentioned in passing in the chapter on respiration, and sulfate reduction is completely ignored. The out-of-dateness appears with painful clarity in the theoretical discussions, particularly in those pertaining to the mechanisms of carbohydrate breakdown and the assimilation of carbon dioxide by autotrophs, where hypotheses that were laid to rest ten years ago are resurrected and made to pass for current concepts. Kluyver's speculations on the intermediate steps in the various bacterial fermentations were brilliantly ingenious and stimulating in 1931, but one hardly expects to find them presented unaltered in a book published fifteen years later. The factual errors are often inexplicable: for example, a hopelessly confused and incorrect classification of the lactic acid bacteria (p. 318) is alleged by the author to represent the system of Orla-Jensen. It is unfortunate that this book was published, and one can only hope that no student will be encouraged to read it.

R. Y. STANIER



DIE ERNÄHRUNGSPHYSIOLOGISCHE BEDEUTUNG DER HEFE. *Beihefte zur Zeitschrift für Vitaminforschung, Nr. 4.*

By J. C. Somogyi. *Hans Huber, Bern.* Schw. Fr. 6—110 pp. 1944.

It would be difficult to overemphasize the importance of the role played by yeast in the remarkable advances of the last decade in the physiology and biochemistry of the cell. As a result of all this activity more is probably known and understood about the yeast cell than about any other unit of living matter. Unfortunately, much of this material is scattered in the biochemical literature. Somogyi has made a modest but extremely useful attempt to gather some of this information together into one monograph. Starting out with the histology of the yeast cell, he covers such topics as organic and inorganic composition, vitamin content, amino acid and protein composition, as well as methods of growing yeast. He also considers the functional biochemical properties of dried yeast as well as yeast extracts.

There is little doubt that this small monograph will be found by most to be a useful collection of desirable information. It is unfortunate that the added effort required for indexing was not expended.

S. SPIEGELMAN



PARASITOLOGY

AN ILLUSTRATED LABORATORY MANUAL OF PARASITOLOGY. *Revised Edition.*

By Raymond M. Cable. *Burgess Publishing Company, Minneapolis.* \$1.65 (paper). vi + 112 pp.; ill. 1943.

This manual should prove to be a very valuable laboratory guide to the parasitology student. Although it was originally designed for the author's courses in this subject, it no doubt can be adapted to many similar courses given in other institutions. The manual is organized in such a logical fashion that other instructors could easily arrange their laboratory sessions to coincide with the sequence presented in the manual.

The author has emphasized the parasites of medical importance; however, other organisms have been included to make it a well rounded manual in general parasitology. The text is well written and includes many pertinent questions that should stimulate the student. The most attractive and valuable feature of the manual is its illustration. Practically every organism discussed is illustrated by a clear drawing. Most of the illustrations are fully labeled, enabling the student to grasp easily the meaning of the text. Although in general the hundred-odd illustrations are excellent, the one of the malarial parasites should be corrected. It is so labeled that it implies that only the immature schizonts of *P. falciparum* are not usually seen in the peripheral blood.

The manual concludes with a rather complete section on laboratory techniques applied to parasitology.

tology. The offset printing is much clearer than the mimeographed type of the earlier edition. The manual possesses an index and a list of selected references.

M. M. BROOKE



MOSQUITOES OF OKINAWA AND ISLANDS IN THE CENTRAL PACIFIC. *NavMed* 1055.

By Richard M. Bohart and Robert L. Ingram. *Bureau of Medicine and Surgery, Navy Department, Washington, D. C.* Free upon request (paper). ii + 110 pp.; ill. [No date.]

The title indicates the main contents of the publication. There is a general introduction describing the collections studied, their sources, and giving notes on technique. The following areas are treated separately: Hawaiian Islands (4 species), Samoa (8 species), Marshall Islands (4 species), Caroline Islands (14 species, of which 3 are described as new, and 4 are placed only in the genus but not described), Mariana Islands (12 species, of which one is a new species and one a new subspecies), Okinawa (33 species, of which 1 is a new species). Keys to adults and larvae are given. Notes on distribution, biology, and relation to disease are summarized under each species. This is a useful summary for those working in the Central Pacific area, as the publication is well illustrated.

R. MATHESON



THE MOSQUITOES OF JAPAN AND THEIR MEDICAL IMPORTANCE. *NavMed* 1095.

By Tsai-Yu Hsiao and Richard M. Bohart. *Bureau of Medicine and Surgery, Navy Department, Washington, D. C.* Free upon request (paper). iv + 44 pp. + 3 plates. 1946.

This publication gives keys to the adults and larvae of 44 known Japanese species. Each species is also treated separately by brief notes (and frequently full descriptions of species) on their distribution, biology, and relation to disease. An added section gives a condensed account of filariasis, Japanese "B" encephalitis, malaria, dengue, and yellow fever in Japan, with detailed statements of the known mosquito vectors. No yellow fever is known to occur in Japan. There is also a valuable bibliography. As most of the work on Japanese mosquitoes is in the Japanese language, this publication is of importance to all workers interested in the fauna of Japan.

R. MATHESON



ATLAS DES PARASITES DES CULTURES. I. *Lutte Antiparasitaire: Orthoptères, Hémiptères, Néuroptères, Lépidoptères.* II. *Coléoptères, Hyménoptères, Diptères, Autres Ravageurs.*

By Raymond Poutiers; preface by R. Jeannel; illustrated by Bernard Couturier. *Éditions N. Boubée & Cie., Paris.* (I) 250 fr. (paper); (II) 250 fr. (paper). (I) 139 pp. + 12 plates; text ill. (II) 129 pp. + 12 plates; text ill. (I) 1945; (II) 1947.

As stated in the introduction, the purpose of these volumes is to make known in limited space the agents responsible for crop damage, the methods of control, and the interrelationships of plants and plant pests. This purpose is most satisfactorily fulfilled. Gathered here is pertinent and interesting information, presented in a manner which will please and benefit the professional and amateur farmer confronted with insect or rodent control problems. Inasmuch as the subject matter deals with agricultural problems in France, these volumes will excite only limited interest in this country. On the other hand, they are excellent examples of what can be done by way of presenting the public with attractive as well as informative accounts of crop pests.

Volume I introduces the reader to natural and artificial methods of control. The following orders of insects are then discussed: Orthoptera, Dermaptera, Isoptera, Odonata, Hemiptera, Neuroptera, Thysanoptera, Lepidoptera. Volume 2 considers the Coleoptera, Hymenoptera, Diptera, myriapods, arachnids, nematodes, molluscs, birds, and rodents. For each there is given a brief accurate description, an indication of damage done to crops, and up-to-date methods of control. Items of academic interest are held to a minimum. For example, metamorphosis is treated only in so far as it will aid in identification or in an understanding of control.

Of more than passing interest is a brief account of the exchange of pests between New and Old Worlds. It may come as a surprise to some to learn that in exchange for the gypsy moth, European cornborer, etc., we have given Europe the Colorado potato beetle, San José scale, and other pests.

The colored illustrations are not only beautiful but of very definite assistance in the recognition of the various pests. The neat caricatures at the ends of each chapter lend an amusing air to the whole. An American counterpart to these little volumes would be an asset to economic entomology in this country.

V. G. DETHIER



HEALTH AND DISEASE

THE HEALTH OF THE SCHOOL CHILD.

By Gertrude E. Cromwell. *W. B. Saunders Company, Philadelphia and London.* \$2.50. xii + 256 pp.; ill. 1946.

A nursing supervisor of the Des Moines Public Schools has here written lucidly and sympathetically of the health problems of children and the role of the school

nurse in the school health program. This is a non-technical presentation of the responsibilities and duties of the nurse, both within and outside of the school building. Some of the common deficiencies and inadequacies of systems in force at the present time, such as poor follow-up of the medical appraisal, are pointed out. The importance of the educational aspects of health programs is emphasized.

HARRIETTE D. VERA



SCHOOL HEALTH PROBLEMS *With an Outline on School Health Administration. Third Edition.*

By Laurence B. Chenoweth and Theodore K. Selkirk; outlined by Richard Arthur Bolt. F. S. Crofts & Company, New York. \$3.00. xii + 419 pp.; ill. 1947.

Broad in scope, modern in point of view, both practical and scientific, this book which proposes to "acquaint students, teachers and others interested with the general nature of school health problems," is considerably better than many publications in its field. Moreover, its size has been kept within reasonable bounds, considering the many aspects and problems involved in such a subject.

About a fourth of the text is devoted to a well written discussion of growth and nutrition. There are two chapters on the physical examination, but they are not too detailed, and this is not a book for a school medical staff. Other topics are covered more briefly. A teacher might be better informed by a slightly different selection of material, e.g., by a more extensive consideration of health teaching and a less technical handling of the subject of endocrine glands.

Some of the more recent developments in knowledge concerning child health have been mentioned or discussed. Yet one could wish, especially in view of the generally high calibre of the book, that this third edition had been more completely revised. Particularly is this true of the chapter bibliographies, for they consist largely of references ten to twenty or more years old.

HARRIETTE D. VERA



WELL AND HAPPY. *Health of Our Nation, Book One.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.08. 156 pp. ill. 1942.

CLEAN AND STRONG. *Health of Our Nation, Book Two.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.12. 180 pp.; ill. 1942.

FIT AND READY. *Health of Our Nation, Book Three.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.24. 243 pp.; ill. 1942.

SAFE AND SOUND. *Health of Our Nation, Book Four.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.28. 279 pp.; ill. 1946.

HALE AND HEARTY. *Health of Our Nation, Book Five.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.32. 303 pp.; ill. 1943.

ACTIVE AND ALERT. *Health of Our Nation, Book Six.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.36. 311 pp.; ill. 1943.

LIVING AND DOING. *Health of Our Nation, Book Seven.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.40. vi + 346 pp.; ill. 1943.

TRAINING FOR LIVING. *Health of Our Nation, Book Eight.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.44. iv + 347 pp.; ill. 1943.

THE HUMAN BODY: How It is Built and How it Works. *Health of Our Nation Series.*

By Clifford Lee Brownell and Jesse Feiring Williams. \$1.60. x + 310 pp.; ill. 1946.

HEALTH PROBLEMS: How to Solve Them. *Health of Our Nation Series.*

By Clifford Lee Brownell, Jesse Feiring Williams, and William Leonard Hughes. \$1.96. x + 317 pp.; ill. 1942.

BEING ALIVE: Human Structure and Functions. *Health of Our Nation Series.*

By Clifford Lee Brownell, Jesse Feiring Williams, and William Leonard Hughes. \$1.96. x + 430 pp.; ill. 1942.

ADVENTURES IN GROWING UP. *Health of Our Nation Series.*

By Clifford Lee Brownell, Jesse Feiring Williams, Katherine M. Conrad, Ruth Evans, A. Abbott Kaplan, Jeanie M. Pinckney, and Dorothy N. Ruff. \$1.96. viii + 488 pp.; ill. 1941.

YOUTH FACES MATURITY: Health Problems. *Health of Our Nation Series.*

By Clifford Lee Brownell, Jesse Feiring Williams, and William Leonard Hughes. 20 cents (paper). 30 pp. 1942.

American Book Company, New York, Cincinnati, Chicago, Boston, Atlanta, Dallas, and San Francisco.

Bright and colorful in appearance, attractively illustrated, well written, carefully graded in difficulty, this series of hygiene books appears to have every feature of merit present-day textbook-makers can offer.

Yet they arouse two questions of grave concern in educational matters. In the first place, is this imposing weight of indoctrination about toothbrushes and the proper handling of sneezes really necessary? and must it be thus repeated year after year, in order to be effective? The first three books may be written off as attractive little readers that might just as well be about any other interesting subject, for the few simple hygienic instructions they contain can, in any case, be

taught best by oral precept and by example. The books for the middle and higher grades repeat the same material, year after year, with gradually increasing depth and scope. One good book at the fourth, or fifth grade level, and another at the ninth or tenth would cover all the subject matter of human anatomy and physiology, diseases, hygiene, and safety precautions, and leave the remaining years free for other important subjects. Isn't the curriculum overcrowded without all this repetition? And wouldn't the increased interest due to the freshness of the subject, if taught only twice in this span of years, more than make up for any value of repetition in learning, especially when the repetition is carried to the risk of boredom?

The second question is of even greater importance. This series, like all others of its sort the reviewer has seen, completely shuns any consideration of reproduction and sex education. A slender, unillustrated pamphlet on these matters is, to be sure, provided with the higher books in the series, for use if the teacher so desires. But it is altogether inadequate. It is high time we awoke to our responsibility in this direction. Many, if not a majority, of the users of these books will leave school, marry, and raise families with no further instruction in such matters. The boys are already in early adolescence, at the maxima of their sexual activities (see the review of Kinsey, Pomeroy, and Martin: *Sexual Behavior in the Human Male*, in this issue, p. 39); while the young girls are faced with the puzzling inner sexual conflict between mature physique and immature emotions. These facts add up to a conclusion now quite generally accepted among leaders of sex education, viz., such instruction should be planned to begin in the middle grades, before the children reach that age when embarrassment makes it difficult to teach them about sex. Only the persistent Victorian attitudes toward sex keep us from an intelligent and vigorous effort to revolutionize this aspect of our education.

BENTLEY GLASS



HEALTH FACTS FOR COLLEGE STUDENTS: *A Textbook of Individual and Community Health. Fifth Edition.*

By Maude Lee Etheredge. W. B. Saunders Company, Philadelphia and London. \$2.50. xiv + 439 pp.; ill. 1947.

This is a highly informative and comprehensive presentation of the subject of hygiene. At the same time it is not very detailed or technical and should be readily understood by college or senior high school students having little or no previous knowledge of the subject. A good share of the book deals with personal hygiene, and enough anatomy is included to provide a sound basis. Pertinent information on public health aspects

has been incorporated throughout, and there is a separate chapter entitled Supervision of Health, and another on Housing.

In this fifth edition since the first printing of the textbook in 1933, a real effort has been made to keep the text up to date. For example, epidemiological statistics are recent ones, and the Rh factor and the relation of fluorine to dental caries are discussed. The bibliography has also been revised to cover recent publications.

Illustrations are not numerous; they consist of charts, diagrams, and graphs. At the ends of the chapters are lists of subjects or questions for class discussion. At the end of the book are a list of films appropriate for classroom use and an index.

HARRIETTE D. VERA



DISEASES TRANSMITTED FROM ANIMALS TO MAN. *Third Edition.*

By Thomas G. Hull. Charles C. Thomas, Springfield, Illinois. \$10.50. xviii + 571 pp.; ill. 1947.

The voluntary association of man with friendly and beneficial animals, as well as his unwanted contacts with other animals, has tended to jeopardize man's health. There are many diseases that are shared by animals and man and others that are passively transferred from man to man by way of animals. This book is concerned with these diseases.

All types of pathogens are considered here: viruses, bacteria, fungi, protozoa, and helminths. They are presented under four major sections: Diseases of Domestic Animals and Birds; Diseases of Rodents and Wild Animals; Human Diseases Spread by Animals; and Animals as Passive Carriers of Disease Organisms. A final chapter summarizes the role played by each animal in the spread of disease.

Although Hull and fourteen contributors have written various parts of the book, each chapter has essentially the same organization. Brief historical accounts of the diseases are followed by thorough discussions of their epidemiology and prevention. At the end of each chapter is a helpful pseudo-summary entitled Items of Note.

The list of contributors includes many important men in the fields of public health and veterinary medicine. The author has been careful to give them full credit for their contributions, acknowledgment being made at the beginning of each such chapter to its author.

This is the third edition of the book, first published in 1930. It has undergone many changes with the advent of new information pertaining to the subject. In comparing the present edition with the second, it is obvious that it has been substantially enlarged and improved. There are approximately two hundred

more pages and many new illustrations and tables. New chapters have been added on listerellosis, Haverhill fever, tsutsugamushi disease, Q fever, jungle yellow fever, and lymphocytic choriomeningitis. Former chapters on louping ill and equine encephalitis have been combined with other similar diseases into one chapter on arthropod-borne encephalitides.

Diseases Transmitted From Animals To Man is an interesting and valuable book, which in its new edition should do much toward accomplishing the aim set forth in the opening paragraph of the author's preface, namely: "The diseases which animals may transmit to man remain of interest to the veterinarian and the physician, the research worker and the health official. Each is engaged with a different phase of the problem and views the subject from a different angle. The third edition, as was the first, is presented with each of them in mind, to afford a common meeting ground where each may understand the problems of the others and thus through concerted effort reduce the number of infections which man contracts from animals."

M. M. BROOKE



REHABILITATION THROUGH BETTER NUTRITION. *University of Cincinnati Studies in Nutrition at the Hillman Hospital, Birmingham, Alabama.*

By Tom D. Spies. W. B. Saunders Company, Philadelphia and London. \$4.00. vi + 94 pp.; ill. 1947.

This interesting monograph summarizes certain experiences in nutritional studies conducted in Birmingham, Alabama. Because of the good response of a small group of patients to treatment, a nutrition clinic was established. Of 10,851 persons examined in the clinic, 5,140 did not have nutritive failure. Those with marked deficiencies were the indigent, those with histories of erroneous dietary habits or idiosyncrasies, people with diseases interfering with the ingestion or utilization of food, pregnant or lactating women or other persons whose physical activities had increased, and alcohol addicts.

More intensive study was devoted to 914 persons between 16 and 65 years old, who were incapacitated by their poor nutritional state, who were without means of changing their diet, and who had no serious organic disease and were not addicted to alcohol. Of this group, 452 had niacin deficiency, 355 riboflavin deficiency, 156 thiamin deficiency, 17 vitamin C deficiency, 61 had pernicious or nutritive macrocytic anemia, and 86 had iron deficiency. Under the prescribed regimes, 893 patients showed improvement and obtained work or went into the armed forces; 21 were unavailable for final check-ups, 9 by reason of death.

The symptoms of the various conditions are described, and corrective diets and representative case

histories are included in the brief and readable text. The teaching of proper dietary habits is emphasized. There are diagnostic charts, colored pictures, considerable tabulated data, and several pages of bibliography. Typography, format, and paper are all of excellent quality.

HARRIETTE D. VERA



RH: Its Relation to Congenital Hemolytic Disease and to Intragroup Transfusion Reactions. *The General Practice Manuals.*

By Edith L. Potter. The Year Book Publishers, Chicago. \$5.50. xvi + 344 pp.; ill. 1947.

The rapid growth of research dealing with "Rh" is vividly revealed by the citation at the end of this book of no less than 794 papers published on the subject since the discovery of the Rh antigen eight years ago. All workers in immunology and hematology, in gynecology and obstetrics, and in human genetics will remain deeply indebted to the courageous enterprise with which Edith L. Potter of the University of Chicago and the Chicago Lying-In Hospital has reduced the heterogeneous subject to an assimilable state. The puzzles of Rh-Hr nomenclature, of the blocking antibodies, of the variable clinical manifestations of hemolytic disease, and of alternative laboratory techniques have been skillfully clarified by the author. Even though she is guilty of fostering such genetic misconceptions as that, among the genes, there is "one gene concerned with the formation of each individual characteristic of the body—eye color, hair texture, and so on"; and that each fertilized egg possesses "hundreds of thousands of pairs of genes"—the author is nevertheless clear and consistent in her explanation of the genetics of Rh itself.

The author is perhaps weakest in her repeated insistence on certain personal views which still remain unsubstantiated, e.g., that abortion renders the isoimmunization of Rh-negative women more likely and that in general immunization occurs at labor and not during the course of pregnancy, as a result of red cells passing through the placenta. But this is a minor criticism of a very worthwhile book.

BENTLEY GLASS



HISTOPATHOLOGY OF THE EAR, NOSE AND THROAT.

By Andrew A. Eggston and Dorothy Wolff. The Williams & Wilkins Company, Baltimore. \$18.00. viii + 1080 pp. + 30 plates; text ill. 1947.

This is in many respects a unique volume of pathology. Not only does it amply cover and profusely illustrate the gross and microscopic features of lesions occurring in the ear, nose, pharynx, and larynx, but it systematically and quite thoroughly reviews the comparative

anatomy, embryology, gross and microscopic anatomy, as well as the physiology of the same anatomical regions. Its comprehensiveness does not stop there, as it also includes a chapter on technic, that indicates how appropriate gross material can be obtained, and what the processes are to be followed in order that full-sized and well-stained sections, from the ear, in particular, may be secured for microscopic study. The beautiful reproductions of such sections of the petrous mastoid and mastoid process in health and in disease are an indication of the success and importance of such technical procedures. There is also a chapter devoted to the discussion of general pathology by way of introduction to those dealing with special pathology. The volume ends with a brief chapter on clinical pathology, in which the value of laboratory examinations in the field of otolaryngology is indicated, as well as the interpretation that is to be placed on these findings.

It is fortunate that the field of otolaryngology is sufficiently circumscribed as a medical specialty as to make it possible to cover within one volume all the important preclinical or basic scientific information relative to it.

The major faults found in the volume were the numerous misspelled words and the not infrequent poorly constructed phrases and sentences.

Cecil Krakower



DISEASES OF THE NERVOUS SYSTEM in Infancy, Childhood and Adolescence. Second Edition.

By Frank R. Ford. Charles C. Thomas, Springfield, Illinois. \$12.50. xviii + 1143 pp.; ill. 1945. The first edition of this book was in 1937. The second edition was issued in March 1945, and a second printing was necessary in May 1946. This record is most convincing evidence that the book has met with approval and answers a need for an inclusive work on the neurological disorders of the early years of life. One must be impressed by the large amount of material treated in this single volume, which at the same time places due emphasis on subjects of practical importance. The first forty-nine pages describe methods of examining the nervous system, history-taking, the physical examination, and special examinations such as electromyography, spinal manometry, and electroencephalography. This last section is covered in less than three pages, and concludes with a helpful statement as to the usefulness of the method from a clinical standpoint, its uncertainty, its limited use in localization, and its use in the diagnosis of epilepsy.

A reasonably detailed section on the embryology, morphology, and physiology of the nervous system is included. This is treated with emphasis on its clinical aspects, with especial attention to the differences encountered in the pre- and post-natal periods and in the early years of life. Further consideration of the

clinical aspects of the nervous system is similarly oriented.

The major portion of the book is devoted to the diseases, injuries, defects, and syndromes of the nervous system. A noteworthy feature is the organization and classification of each general section, such as the Prenatal Diseases, the Heredofamilial and Degenerative Diseases, and the Infectious and Parasitic Invasions of the Nervous System, to mention only a few. The classification of the infectious diseases is based first on their etiology and secondarily on the pathological anatomy, which fulfils the author's intention of permitting rapid orientation.

Treatment is dealt with in a candid way, often with the statement that no specific treatment is known, or that treatment is symptomatic. It might be useful if some mention were made of therapeutic methods, even those of little or no value, to prevent needless repetition of such therapeutic trials. However, this would no doubt require excessive expansion of the book.

In short, this is a book which is valuable both as textbook and for reference. It deserves a place on the shelf of anyone dealing with the diseases of infancy and childhood.

LOUIS F. CLEARY



IT'S AN ALLERGY.

By Frank G. Crandall, Jr. Murray & Gee, Hollywood. \$3.00. 318 pp. 1946.

This book has been written for the purpose of explaining allergy "so that the public can understand more fully this important field of medicine." The author makes this statement in the preface. In order that any such education might be satisfactory, an author should be most discriminating in his selection of the data to be presented to the lay reader. Controversial phases of the subject should be omitted from such a publication, for their discussion produces confusion rather than understanding. Furthermore, the imagination of a susceptible reader can stretch to such a degree that his reward for reading this book may well be a pseudo-allergy.

The author has written a three-hundred-and-five page book, consisting of fifteen chapters. The first four of these are respectively devoted to the definition, frequency, diagnosis, and treatment of allergy. In the next ten chapters, various allergic manifestations are discussed. In the final chapter, the author gives the patient specific instruction in the management of allergic diseases.

To illustrate the manner in which allergens afflict a patient, many interesting case reports are presented in appropriate context. Undoubtedly these experiences encountered by the author will be of great interest to any reader, but of paramount interest to that partic-

ular reader who sees in some case report a possible explanation of his own allergic condition.

The author is an advocate of testing his "patients with extracts of several hundred different allergens." He states that "until the advent of allergy, medicine offered no adequate explanation of stomach ulcers," and then he renders the opinion that "in practically every instance, ulcers are either caused or aggravated by food allergy." The chapter relating to allergy of the nervous system might have been condensed into two pages; instead, the author has discussed entities which have nothing whatever to do with allergy. These are a few examples of the errors of commission which are to be encountered in this publication. The reviewer's conservative judgment is that the publication will be more likely to confuse the lay reader than to give him a clear understanding of allergic diseases.

LESLIE N. GAY



MONGOLISM AND CRETINISM: A Study of the Clinical Manifestations and the General Pathology of Pituitary and Thyroid Deficiency.

By Clemens E. Benda. Grune & Stratton, New York. \$6.50. xvi + 310 pp.; ill. 1946.

Mongols and cretins have been confused with each other, as the author points out, for ages. As to the mongols, a fertile modern source of confusion has been the name itself. It is therefore surprising to read that the classic description of this type by Seguin in 1866 rightly recognised its most obvious facial characteristic as being due to a curtailment of the skin at the margin of the lid. Unfortunately, the ethnic predilections of Langdon Down, writing in this same year, prevailed, and finding a congenial acceptance in nineteenth century assumptions, remained to becloud the etiology of this condition. The dilemma of the Chinese physician who finds the disease in his own population is apparent. From the compelling arguments of the author, mongolism is congenital acromicria, or pituitary hypoplasia, and the bony development found is the obverse of that in acromegaly. The large series of cases (300) studied, some over a ten year period, makes much of the work reported definitive in this field. Because of the large amount of comparative data he has been able to supply, the author seems justified in adding his observations on cretinism, or congenital thyroid aplasia, to this volume.

Many fields are considered in relation to these conditions; one would hesitate to agree, in regard to endocrine treatment, that "we need pituitary extracts from immature animals" for the treatment of children. In view of the large amount of case history and tabular material presented, one would like to have found a final chapter summing up the entire field, along the lines of the synopses scattered through the book.

H. R. CATCHPOLE

GYNAECOLOGICAL ENDOCRINOLOGY For the Practitioner.

By P. M. F. Bishop. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$2.00. viii + 124 pp. + 1 chart. 1946.

The reviewer has an ingrained aversion to synopses and compendia, and so when he opened *Gynecological Endocrinology* he did it begrudgingly. However, after reading the first several pages he changed his attitude, for here is a succinct, accomplished statement of the practical aspects of the hormones in relation to gynecology.

The endocrine control of the menstrual cycle is first summarized. The several sex hormones and their modes of administration are discussed. With these fundamentals established Bishop then diagnoses and treats the various aberrations of menstruation: amenorrhoea, hypomenorrhoea, hypermenorrhoea, oligomenorrhoea and polymenorrhoea. Painful menstruation, the menopause, infertility, and pregnancy are each similarly analyzed in separate chapters. The book is concluded with a description of the three biological pregnancy tests and a confession of how laborious, inexact, and impractical are the modern methods of hormone assay. An appendix of 20 pages lists the commercial hormones available in December, 1945, their manufacturers, modes of administration, doses, and prices in British coinage.

The author is intensely practical, frank, and conservative. He obviously knows the literature but does not clutter his very brief treatise with a review of pertinent articles. The book is well adapted to the intelligent general practitioner and the open-minded gynecologist as well.

The reviewer wishes that the type had been reset for the American printing, for the constant use of such words as "shewn" is distracting, and also the prices of drugs in England are of little guidance to the American practitioner. The reviewer further considers the thyroid a gland with important gynecological effects and thinks that its exclusion in such a brochure is an oversight. The treatment of habitual abortion is too didactic, the author only mentioning progesterone in its treatment and not even hinting that such therapy may have little value and that many believe thyroid and stilbestrol are far superior. Several minor faults could be listed, but all in all Bishop does a most competent and orderly job in a very few pages.

ALAN F. GUTTMACHER



EXPECTANT MOTHERHOOD. Second Edition, Revised.

By Nicholas J. Eastman. Little, Brown and Company, Boston. \$1.50. xiv + 198 pp. + 2 plates; text ill. 1947.

Advice books about pregnancy antedate the printed page, and if all placed side by side a large library would result. Among the most widely read of the modern

era is Eastman's *Expectant Motherhood*, first printed in 1940. During the succeeding seven years it was reprinted fifteen times and currently appears completely revised.

Expectant Motherhood is written for the intelligent layman. The author captivates the reader by his authoritative, sincere, simple style; a style devoid of window-dressing. A great amount of valuable, practical information is packed into the small volume. If one were to offer any general criticism, he might take the author to task for the almost complete absence of historical data, a field in which the author himself has frequently demonstrated his special competence. The only excursion into medical history which he has allowed himself is a few paragraphs concerning the origin of the obstetrical forceps. The reviewer feels that medical books written for the layman should not only present the essential facts, but the historical evolution of their acquisition. Such a combination educates the public in an appreciation of modern scientific medicine, plus a better understanding of its peripheral quackery.

Several new chapters have been added to the first edition. One of these is an excellent chapter on weight control in pregnancy, with sample menus. "How to telephone your doctor" is an intriguing inclusion, its purpose—to make telephone consultations more efficient and satisfactory. Paragraphs on the much discussed Rh factor and on controversial caudal anaesthesia first appear in the revised edition.

In one instance Eastman allows faith in democracy to outweigh scientific critique. Because 84 per cent of seventy-five obstetrical authorities assume that smoking and inhaling twenty-five or more cigarettes daily have an unfavorable effect on the health of the pregnant woman, he too implies that this is the case. Yet neither he nor the other authorities offer scientific data to support this prejudice.

All in all, *Expectant Motherhood* does an excellent job. Eastman makes a painstaking attempt to replace the subtle fears and folk misinformation of the pregnant woman and her near kin, by calm assurance and scientific knowledge. And he succeeds.

ALAN F. GUTTMACHER



THE PROBLEM OF FERTILITY. *Proceedings of the Conference on Fertility held under the auspices of The National Committee on Maternal Health.*

Edited by Earl T. Engle. Princeton University Press, Princeton. \$3.75. x + 254 pp. + 6 plates. 1946.

This volume is a continuation, along similar lines, of the series of proceedings of the annual conference on fertility, sponsored by the National Committee on Maternal Health, and under the editorship of Earl T. Engle. Previous proceedings have been published in various ways but none as elaborately as this one. As in the previous proceedings, the papers cover a num-

ber of fields but have a common focus. Unfortunately, the title does not suggest the real breadth of view nor the wide background that the book reflects. Actually much of it is a very important excursion into the field of reproduction in the domestic animals, a field in which the workers are fully aware of the work done clinically and on the laboratory animals, but which is almost unknown and practically ignored by most workers not directly concerned with agriculture. The editor is to be congratulated for bringing the two fields together and in producing the volume.

Of sixteen papers, the first six deal with a wide variety of mammals. This section is useful in introducing the reader to the work done on the domestic animals, ranging through patterns of estrous cycles, histological studies of the maturing ovarian follicle, the induction of ovulation, the hormonal control of ovulation, and a review of the work on ovulation and estrus in sheep and goats. The two papers following report on a much more restrictive field of study: the cervical mucus of the human female. The second of these, on spermatozoa and cervical mucus, leads rather naturally to the next section. Its five papers give extensive accounts of research on the spermatozoa of human, rabbit, bull, and horse. In some respects this section is the most homogeneous section of the book.

Three papers do not fit into the three sections mentioned above. The final paper in the volume is a discussion of methods used in the determination of the time of ovulation in the larger domestic animals. The effects of thyroprotein on the reproductive capacity of bulls is discussed in another paper; and a third paper discusses the cervix uteri in sterile matings. In this paper two statements deserve comment: one wonders why J. Marion Sims is "Marion Sims of Paris"; and again, what comment Reginald the office boy (of hallowed memory) might make on the author's device of calling artificial insemination "semi-adoption."

ROBERT K. ENDERS



THE VENEREAL DISEASES: *Manual for Practitioners and Students.*

By James Marshall. Macmillan & Company, London. \$4.50. xii + 348 pp. + 8 plates; text ill. 1944.

Most of the text is devoted to a detailed description of the numerous manifestations of gonorrhea and syphilis. Other venereal diseases and lesions and conditions encountered in venereology are discussed more briefly. The fact that "diagnosis precedes treatment" is emphasized, and a plea is made for careful and thorough examination of patients. Instructions for treatment of gonorrhea with sulfonamides and of syphilis with bismuth and arsenicals and other practical techniques are included.

The manual was, unfortunately, written before

penicillin became readily available and relatively inexpensive, so other sources must be consulted for newer methods of therapy.

Illustration is by means of a few diagrams and numerous photographs, a number of which are reproduced in color. A very short bibliography and an index complete the book.

HARRIETTE D. VERA



EXPERIMENTS ON THE PRESENCE OF CARCINOGENIC SUBSTANCES IN HUMAN SURROUNDINGS.

By Theodore van Schelven. Kosmos Publishing Company, Amsterdam, Holland. \$1.00 (paper). 16 pp. 1946.

This is a mere pamphlet or reprint stating the author's views on the cause of cancer. The views expressed are supported by data from experiments that appear to be thorough and well done. It is stated that the partial carbonization which takes place when foods are subjected to certain ordinary kitchen procedures is accompanied by the production and appearance of carcinogenic materials with black crusts. The author suggests that "a slight correction of our basic kitchen techniques seems to be advisable: boiling and stewing, even with the formation of brown crusts being apparently inoffensive, the avoidance of the formation of black crusts in the processes of roasting, frying and baking might be desirable."

The basic facts presented in the paper are not new, in spite of the attempt to create such an impression. Numerous other investigators have shown that heating diverse substances and materials to produce tars and crusts gives rise to carcinogenic substances. The only point of difference in technique, as compared with those used by other investigators, appears to be the limitation of the heating to "ordinary kitchen techniques." It is more than regrettable that there is no bibliography.

FRANK H. J. FIGGE



MUSIC IN MEDICINE.

By Sidney Licht. New England Conservatory of Music, Boston. \$3.00. xx + 132 pp. 1946.

This short book is a simple, general survey of musical therapy, written, as the author states, "with a view to preserving for medicine that which is good for patients, in an attempt to aid musicians under medical guidance in using music to help the sick."

Some chapter headings will convey the form and emphasis of the text. For example, Licht begins with The History of Music in Medicine, including references to music in primitive and ancient civilizations up to recent times, including literature from various periods. The following chapter, on the Philosophy and Psychol-

ogy of Music, emphasizes in general the moods and emotional reactions that may be suggested by various instruments and musical scores. Following this come Music as Occupational Therapy, Psychiatry and Music, and subsequent chapters that deal with the use of music in the background, at mealtimes, and for diversion. Some mention is also made of programming equipment and lastly of the medical direction. Training for such work, Licht believes, should be carried out by cooperation between musician and doctor.

Some may feel that this work belongs to those of special interest and training in the department of Occupational Therapy. Fortunately, Licht has kept in mind the need for critical analysis of the scope and possibilities of music as a therapeutic agent rather than the mere tool of a "healing cult."

At present, it is difficult to see how music may be fitted into an acutely crowded hospital program so as to give more than the usual lift of entertainment appropriately applied. On the other hand, it is to be hoped that through further interest and research the possibilities it may offer in the more chronic states of illness will be explored and the doctor given more specific aid in his work.

LUCILLE CARTER



HEALTH INSURANCE IN THE UNITED STATES. *Studies of The New York Academy of Medicine Committee on Medicine and the Changing Order.*

By Nathan Sinai, Odin W. Anderson, and Melvin L. Dollar. The Commonwealth Fund, New York. \$1.50. xvi + 115 pp. 1946.

Much factual material has here been condensed into a short but significant publication dealing with the history, development, and trends of group health prepayment plans. The text centers around voluntary hospitalization plans, as exemplified by the Blue Cross and the medical service plans sponsored by medical societies (e. g., that of Michigan), since these two types have the largest enrollments and are the most active and important at the present time. Attitudes which have been held by professional, lay, and government groups toward such plans are summarized. Enabling legislation is also discussed, the characteristic features and inadequacies of voluntary plans are surveyed, and the problems that confront the extension of their services are analyzed.

This valuable monograph is another of the series prepared under the auspices of the Committee on Medicine and the Changing Order, of the New York Academy of Medicine. It is recommended for reading by every one who possesses any social consciousness. Because the American scene is a changing one, and because the health insurance movement is advancing rapidly, it is to be hoped that revisions of this book will be published frequently.

HARRIETTE D. VERA

PSYCHOLOGY AND ANIMAL BEHAVIOR

ENCYCLOPEDIA OF PSYCHOLOGY.

Edited by Philip Lawrence Harriman. Philosophical Library, New York. \$10.00. viii + 897 pp. 1946. There are so many things wrong with this book that it is laborious to list them. Most of them pertain to the discrepancy between what an encyclopedia ought to be and what this book actually is. What it ought to be, I suppose, is a well-classified directory of knowledge. In fact, it is a poorly organized assortment of items which range from elaborated dictionary definitions to long treatises. Its chief weakness is lack of balance, organization, and sound allotment of space to various topics; in short, a weakness of editorship. Although the reviewer must not be presumed to have read every article in the book, he has found little to criticize in the content of those that he did read. True, some are mediocre, but many are first class. As a group, the individual contributors are not to be blamed for the deficiencies of the book. This brings us back to the responsible person, the editor.

The index is less than 3 pages long, which is insufficient, for it is mainly an index of titles and not of topics. This makes it hard for the reader to find anything on "Drive," for example, because there are no articles with titles beginning with D. No mention of Instinct in the index either, though of course P. T. Young's chapter on Motivation discusses both. As to space allotment, Primary Abilities is discussed by Thurstone in 1½ pages, whereas it takes Barr more than 15 pages for Personnel, Teacher—and Porteus nearly 7 pages for Porteus Maze Tests. This is shockingly disproportionate, but at least these topics are, legitimately enough, dignified by treatment as special articles, which is more than the editor allowed Audition, Vision, Kinesthesia, Imagination, Feeling, Judgment, Reasoning, Memory, Statistics, or History of Psychology, just to take a sample of common textbook topics which come to mind. Of course these topics are not *totally* ignored. One can run down parts of several of them, hiding under other titles. How many readers are going to want to hunt out these topics without the aid of a topical index? One last evidence of peculiar selective emphasis: The *only* person mentioned in the entire index, and allowed a special article, is C. G. Jung!

No doubt a statistical count of omissions and errors would portray the book's deficiencies more accurately than these selected examples, but the book is hardly worth such close examination. It certainly is not a good encyclopedia. I cannot recommend it as such to the "serious investigators" or to the "undergraduate and graduate students" mentioned by the editor as possible readers. Furthermore, it would give a seriously distorted picture of psychology to non-psychological scholars.

S. B. WILLIAMS

ADJUSTMENT TO PHYSICAL HANDICAP AND ILLNESS: A SURVEY OF THE SOCIAL PSYCHOLOGY OF PHYSIQUE AND DISABILITY. *Social Science Research Council Bulletin 55, 1946.*

By Roger G. Barker, Beatrice A. Wright, and Mollie R. Gonick. Social Science Research Council, New York. \$2.00 (paper). xii + 372 pp. 1946.

This is an admirable and interesting presentation of objective data and corresponding impressions which deal with the relations between physique and behavior. The authors use the term physique to denote "any structural or functional aspect of the physical organism except the central nervous system." These relationships are referred to as "somatopsychological."

Among the sections of the survey are those devoted to crippling, tuberculosis, and impaired hearing. Especially interesting was the portion of the chapter on Normal Variations in Physique that deals with "overlapping situations and adolescence." Illustrations stress the problems of the adolescent which occur when the rapid change in physique associated with maturation make possible or require of him adult activities for the first time. The objective questions raised regarding the source of behavior in the various individual types are uncolored by the prejudices often encountered in those of a more medical bias and are thereby stimulating. This is especially true of the section on the tubercular person. The lack of medical bias, on the other hand, may also account for the fallacious opinion of the authors that they can study or have studied factors that are unrelated to the central nervous system. A somewhat conspicuous shortcoming of the study appears in the paucity of observations relating to early dynamic family relationships and their contributions toward the form and degree of individual reaction to variations of physique, crippling, or other disabilities, etc.

PAUL GRAY



THE RELATION OF PARENTAL AUTHORITY TO CHILDREN'S BEHAVIOR AND ATTITUDES. *The Institute of Child Welfare, University of Minnesota, Monograph Series, Number XXII.*

By Marian J. Radke. The University of Minnesota Press, Minneapolis. \$2.00. x + 123 pp. + 1 plate; ill. 1946.

PATTERNS OF PARENT BEHAVIOR. *Psychological Monographs, Volume 58, Number 3, Whole Number 268.*

By Alfred L. Baldwin, Joan Kalhorn, and Fay Huffman Breese. The American Psychological Association, Northwestern University, Evanston, Illinois. \$1.50 (paper). iv + 75 pp. 1945.

These two monographs represent efforts to assess, through the research psychologist, what goes on between children and their parents. Neither paper, of course, purports to cover the whole field of this

complicated relationship. The respective authors are fully aware of nuances and undercurrents which even the most ingenious statistical method cannot reach. However, by an intelligent limitation of their research goal, each has provided a significant contribution to the better understanding of parental attitudes and their ultimate effects.

The authors approach the issue from entirely different angles. Marian Radke describes her project as a study of the "nature of parental authority and discipline relations and their correlates in the behavior and attitudes of pre-school children." To do this she took as subjects 43 pre-school children from upper middle-class urban society. Through parental questionnaires, teachers' ratings, two individual but systematized interviews with each subject and an oral questionnaire given to each child, she obtained considerable data upon which to evaluate the home relationships and the children's behavior in response to them.

The investigator found, in this survey of her rather special group, that in this generation there has been a decrease in the emotionality of parent-child discipline situations, a decrease in autocratic methods of control, and an improved parent-child rapport. The pre-school children she interviewed were surprisingly cooperative and informative. From assessing the children's point of view, Radke observed that many adult-inflicted disciplines are completely misunderstood by the pre-school child, who reacts with fear of the parent rather than with a realization of why punishment has been meted out. The result is an undermining of the child's sense of confidence and security rather than a valid gain in social control. The author feels that this area merits more investigation, in order to see if disciplinary measures cannot be geared more satisfactorily to the child.

Baldwin, Kalhorn, and Breese, on the other hand, have developed their study from the material of a much larger research program being conducted by the Fels Research Institute. This Institute was set up to make detailed chronological studies of children from before birth to maturity. 125 cases, thoroughly evaluated by statistical and clinical methods, were utilized by this group. They postulate their aim as being "to discover attitudes which underlie some common patterns of parent behavior, to relate these attitudes to other aspects of the home, and . . . to show the relationship between these parental attitudes and the developing personality of the child."

These investigators, making careful use of their highly impressive assemblage of data, break down parent behavior into three fundamental syndromes, with plus or minus ratings—democratic (as opposed to autocratic), indulgent (as opposed to casual), and acceptant (as opposed to rejectant). The parent group was then subdivided into seven secondary syndromes, each with a characteristic picture. It was found that these syndromes could be correlated posi-

tively with the intelligence of the parents. It was also established that these basic patterns observed by the authors were related to meaningful and explicable trends in the children. It became apparent that the children from a home environment classified as "democratic-acceptant" were the most comfortable and confident youngsters.

In both these monographs the authors have established the need for further research in the evaluation of parental attitudes. In no way do the two papers overlap, either in material or in procedure. However, despite their separateness one feels that each study has hit on the same basic principle of child-parent relationship, namely, that children do understand and respond more happily to a warm, mature, and democratic family atmosphere than to any other. The question next becomes how to use this principle in educating adults for more effective parenthood. Further studies will, no doubt, elucidate the factors which hinder or implement the principle. It is to be hoped that these investigators will all continue their contributions in this area.

HELEN HEWITT ARTHUR



UTILIZING HUMAN TALENT: *Armed Services Selection and Classification Procedures.*

By Frederick B. Davis for the Commission on Implications of Armed Services Educational Programs. American Council on Education, Washington, D. C.

\$1.25 (paper). x + 85 pp. + 1 plate; text ill. 1947.

The series of which this pamphlet is a part is intended to examine the educational programs of the armed services and to seek implications for civilian education. This particular contribution is concerned with the implications to be derived from the procedures used in the selection and classification of service personnel. The author has clearly made an effort to offer something to each of several very different groups. For the relatively uninitiated there is a brief factual description of the selection and classification procedures employed by the various services. For those who want practical suggestions with a minimum of worry about theoretical background, there is a presentation of ten neat implications. For the more technical-minded, there is an appendix devoted to more technical problems.

Although comprising only 31 of the 85 pages, the section dealing directly with the implications is undoubtedly the meat of the contribution. The first section merely provides general orientation, and the appendix is truly an appendix. The hurried reader, by the way, could safely omit the first section with its general description. There is very little specific reference to it, or use made of it, in the development of the argument regarding the implications.

We are warned that only sparse and trite implications

for civilian education should be expected from the program of the services. The service programs, after all, relied chiefly on techniques and procedures derived from civilian education in the first place. For some of the implications the warning is well given. We are told, for instance, that many more apt students in various fields could be discovered, and guided more efficiently than at present into suitable training, by a use of better (and longer) aptitude tests, and that the progress of these students might be better evaluated through tests having norms drawn from widespread regions. Rising one cut above these rather platitudinous implications, we find some important, if not startling, suggestions. There is no royal road to aptitude testing. Although a test of fundamental scholastic aptitude is useful, it is not nearly enough. There is usually some specific test which excels the general test as an indication of a special aptitude. These specific tests, to be of maximum use, must be more complex than we may like to think. They must be longer than those now in use, and must give separate measures for a larger number of factors than we are accustomed to deal with. There are other important emphases regarding the influence of a restricted range of talent, and the importance of realistic validity in a criterion test, even at the cost of reliability. We are also cautioned not to expect the insight of the clinician to add appreciably to the predictive value of test results.

There is little attempt at a rigorous justification of any of the implications. Perhaps that would have been out of place. But the problem might have been raised, and an appendix might have given some hints, at least, as to how we might go about demonstrating some of the assertions made. What evidence is available, for instance, to demonstrate that "*Effective* (italics added) educational and vocational guidance can be provided...?" Even if clear demonstrations are not possible, we might be told whether a particular implication is based on the fact that the services merely used a given technique, or that some officers liked it, or that there is objective evidence of its effectiveness.

One might have expected a richer harvest of implications and on a grander scale. The unique thing about the Armed Services, after all, was not their use of novel techniques of selection, but the sheer size of the enterprises. We remember the enormous number of cases, the appalling degree of control, the vast resources in money and in technical skill. There was also an unparalleled opportunity for boldness, as when a large number of apparent misfits was sent through a training program merely to test the validity of the selective procedures. What are the implications from these features of the program? Can the civilian agencies expect satisfactory results with fewer cases and with less direct control? Must we be prepared to multiply our technical staff to parallel the technical services used by the services? Along with a scarcity of impli-

cations of this nature, one notes relatively little distinct discussion of techniques for "selecting" emotional misfits or other persons in need of therapy.

It is probable that a book which would have escaped these strictures, would, by that very fact, have failed to accomplish the purpose of those who originated the series. This contribution to the series probably does what it was supposed to do. It provides a clear un-worrisome discussion of a minimum list of implications which, even when trite, can bear restatement.

J. M. STEPHENS



THE PSYCHOLOGY OF EVERYDAY LIVING.

By Ernest Dichter. Barnes & Noble, New York. \$2.50. xii + 239 pp.; ill. 1947.

Most of this book consists of short sketches already published in the *Journal of Living*, in *Look Magazine* (Psycho Quiz), *Coronet*, or other magazines. The sketches or talks are extremely short, rarely exceeding five pages. They cover a variety of subjects, most of them being oriented to the little things of life.

The first general division deals with attitudes and emotions. It consists of fifteen sketches on such topics as running away, meeting challenges, tolerance frustration, and the like. Other divisions are: Getting Fun Out of Life, Winning Social Prestige, Health and Efficiency, and A Task for the Social Engineer.

In the first division there is some coherence. The coverage, of course, is by no means complete. The method of making the book precludes an adequate system of selecting the topics falling under any division. Even making allowances for this fact, however, it is disturbing to learn, by implication, that fun in life stems exclusively from automobiles, cigarettes, and radios. No wonder our ancestors were a glum lot! It may also be surprising to find so overwhelming a role played by soap, cosmetics, apparel, and liquor in the problem of winning social prestige.

In most sections there is an understandable avoidance of long or complicated sentences. Photographs are used very freely but not always with much point.

J. M. STEPHENS



PSYCHOLOGY IN LIVING. New Revised Edition.

By Wendell White. The Macmillan Company, New York. \$2.95. xx + 393 pp. 1947.

Psychology in Living will probably interest readers of this journal chiefly as a book to recommend to friends who want helpful advice. There are two parts. The first, dealing with personal relations, is the most unusual. It presents an intensive analysis of the problem of influencing people while still keeping them as friends. This treatment is unusually rich in practical illustrations, whole pages being given to the actual words

which might be used to accomplish various purposes. The advice which accompanies this analysis is difficult to evaluate. There is, of course, no pretense of experimental verification. As far as sheer general impression is of interest, the suggestions seem shrewd, plausible, provocative, and convincing. The reviewer found himself commenting, "Sounds like a good idea" or "Must try that sometime."

The topic of love would appear to have an unchallengeable claim to a position under the heading of personal relations, and White so includes it. In spite of the logical propriety, however, the tone of this section is so different from that of the personal relations earlier discussed that one feels an abrupt transition from directors' meeting to trysting place. This section, although marked by its dependence on common sense, makes considerable use of classical psychological data.

Part Two, treating the field of mental hygiene, uses traditional psychological concepts. This section seems no better and no worse than many other current treatments. Perhaps there is more emphasis than usual on such moral or ethical problems as jealousy or envy. This is in line with the general centering of interest on problems to be solved rather than on the evidence available for their solution.

This is clearly a book for the practical man who wants specific suggestions for improving his salesmanship, his persuasiveness, and his social effectiveness. It is a compendium of advice presented in a practical, lucid and forceful manner. In the opinion of this reviewer, it is one of the better books of its kind.

J. M. STEPHENS



PERSONALITY: A Biosocial Approach to Origins and Structure.

By Gardner Murphy. Harper & Brothers, New York and London. \$5.00. xiv + 999 pp. 1947. Few modern scientists dare attempt to describe the "whole personality." It is perhaps the "64-dollar question" of modern psychology. The question is so enormous and our data so meager that most writers prefer either to leave it alone, or, to judge by current titles, to tackle it bit by bit. It is much easier to test one Freudian hypothesis by an ingenious experiment or to review the inconsistencies in a colleague's thinking than it is to develop one's own complete and systematic description. It is therefore an occasion for applause when we see a man brave enough to take on the big question.

Gardner Murphy is chairman of the Department of Psychology at City College, New York. He has already won a reputation as an outstanding "library scholar," that is, a person whose talent lies in the evaluating of other people's researches. The book reflects a voluminous amount of reading on Murphy's

part and a considerable digestion of what he has read. He does not pretend to offer a new theory, but, by way of evaluating most of the modern theoretical ideas, he does perhaps give the reader a new orientation. By a kind of dialectic, Murphy concludes that no present theory, or methodology for that matter, is sufficiently satisfactory for a complete description of the human personality, though each is minimally satisfactory for small segments of the entire task.

The book is, more than anything, a modern and sophisticated essay, or series of such essays, intended for readers who are already familiar, at least in a general way, with the experimental and clinical literature. It is rather too long (one short of a thousand pages) and too discursive, which tends to make it dull reading. Further, Murphy appears too eager to synthesize and to integrate and is not always penetrating enough in his critical analysis. This gets him sometimes into the silly position of integrating other people's ideas if they come from "respectable" experimental or clinical sources, whether they represent real, tested facts or not.

These are relatively minor criticisms. In spite of emphases not always to the reviewer's liking, the book does contain a great deal of stimulation for the serious student. It is, in a sense, genuinely comprehensive. It is relatively free of dogmatism, which cannot be said of some other books in the same field.

STANLEY B. WILLIAMS



DESCRIPTION AND MEASUREMENT OF PERSONALITY. Measurement and Adjustment Series.

By Raymond B. Cattell. World Book Company, Yonkers-on-Hudson, New York. \$4.00. xx + 602 pp. 1946.

Psychology as a profession has undergone significant changes in the last few years. The impact of the war produced a need for psychologists to predict the behavior of large numbers of people in a variety of real-life situations. This need was both genuine and immediate. Many psychologists left their laboratories in response to it, and the field now teems with clinical, consulting, personnel, vocational, and applied psychologists.

But there is cause for serious concern in this turn of affairs. Too much recent research is devoted to the practical, superficial prediction of behavior of specific kinds; too little to the integrative study of the dimensions of human abilities and personalities. Too often is there a slavish devotion to published psychological tests because "they seem to work"; too seldom is there any critical inquiry into precisely what these tests measure. Though a clinical psychologist himself, Cattell is a severe critic of the empirical "ad hoc research finding, permitting no generalization to other situations and requiring to be re-proved in each of a

thousand situations." For this reason alone, his book is a welcome and refreshing addition to this field.

This is the first of two books attempting to bring into perspective the knowledge we have regarding personality, and to suggest problems and methods for further organized research. The present volume is mainly concerned with cross-sectional studies; the second volume, to be published later, will stress the developmental approach.

The first part of the book is a methodological introduction which amplifies in great detail the use of factor analysis for discovering and isolating personality traits. This is heavy reading—it demands familiarity with correlational procedures, advanced general statistics, and the basic devices of factor analysis. But the methods treated here are well worth careful study, for, in the reviewer's opinion, they represent about the only way of achieving any coherence and system in the description of personality.

The second part of the book will probably interest more readers. In it, the author has attempted to review all earlier work on the description of personality. Studies are grouped into four categories depending on the source of the data: clinical observation, behavior rating, questionnaire, and objective test measurement. In each case, the author tabulates and compares the principal traits isolated. The final chapter lists 12 source traits which consistently emerge in the great majority of the studies, irrespective of the kind of data used. These 12 traits occur so often that they may be considered as established primary traits of personality. Each of these primary traits is described in detail.

All in all, this book is an important contribution to the field of personality measurement. It is a fairly difficult book, highly theoretical, and suitable as a text only for advanced courses and seminars in personality. The clinician and practical psychologist will probably be disappointed in it, for, despite its title, there is virtually no discussion of specific tests or measurement devices for assessing personality. Even so, its systematic contribution is so great that it must certainly be classified as required reading for psychologists in this field.

A. CHAPANIS



INSIGHT AND PERSONALITY ADJUSTMENT: *A Study of the Psychological Effects of War.*

By Therese Benedek. The Ronald Press Company, New York. \$4.00. xii + 307 pp. 1946.

This is a well organized, readable book about the psychological effects of war, as it has impinged not only on the soldier but also on his parents, his siblings, his wife, and his children. It is designed particularly as an orientation study for social workers, clergymen, teachers, and others who are dealing in guidance roles

with people who have been affected and modified by the mass upheaval of the recent conflict.

Therese Benedek has divided her book into four parts. A short but practical opening section of 40 pages is entitled: The Individual. In it the author deftly outlines the psychodynamics of individual development as a background for her more specific thesis.

Part Two, The Soldier, is a comprehensive study of how the civilian male makes an adjustment to becoming a soldier, of how Army life influences him, and of his problems of readjustment on returning to a civilian status. The author develops her theme on the basis of the unconscious motivations and reactions which take place, and she does this in a direct, matter-of-fact style that is understandable and convincing.

In a similar forthright fashion, she takes up Part Three, The Family in War, and elucidates the complicated emotional situation between mothers and soldier-sons. She also describes the relationship between fathers and soldier-sons, the reactions of soldiers' siblings, the unconscious issues between soldiers and their wives—both during separation and on being reunited—the psychological process of mourning, the disabled soldier, and the complex emotions involving soldier-fathers and their children.

Part IV, Men, Women: The Changing Sexual Mores, is utilized by Benedek to go more fully into the impact of the war on social groups other than the soldiers themselves, i.e., on the adolescents and women. In attempting to make intelligible our social structure of today, the author emphasizes the importance of a general shift in what were once rather clearly defined emotional supporting roles. Without an appreciation of how the wartime adolescent has been precipitated into adulthood and how women have assumed a new (if uneasy) status, both emotional and economical, no guidance worker can hope to make a genuine contribution toward another individual's adjustment within this changing social scheme.

Altogether Benedek has written a very worthwhile book. It is a lucid, undramatized account of what has happened, emotionally, to people since war was declared. It should be read not only by professional counselors and psychologists but by all to whom so cogent a summary of the effects of war on our society might be a useful and thought-provoking message, giving a better understanding of the personal struggle our adult and teen-age population is now engaged in.

HELEN HEWITT ARTHUR



MILITARY NEUROPSYCHIATRY. *Research Publications, Association for Research in Nervous and Mental Disease, Volume XXV. Proceedings of the Association, December 15 and 16, 1944, New York.*

Edited by Franklin G. Ebaugh, Harry C. Solomon,

and Thomas E. Bamford, Jr. *The Williams & Wilkins Company, Baltimore*. \$6.00. xviii + 366 pp.; text ill. 1946.

This interesting volume comes at a rather late date, some two years after the war. However, it still sheds light upon the attack on psychiatric and neurological problems that faced the Medical Corps of the Army and the Navy during the past war. The Proceedings include thirty-three papers by such contributors as Whitehorn, Grinker, and Rome—to name only a few.

Most of the material presented at the meeting dealt with the neuropsychiatric difficulties that were becoming more and more apparent as the war progressed, and even late in 1944, one and one-half years before the war ended. Thinking aloud seems to have occupied a good deal of the time of the contributors, as various ones among them made great efforts to compare the psychiatric problems that were seen during World War I with those met currently. Whitehorn offered a triangulation theory concerning the diagnostic nomenclature for psychiatric casualties. Other contributors dealt with malingering, war neurosis in fliers, emotional problems of demobilization, psychiatric reaction to amputation, combat exhaustion, and other pertinent topics, all of prime importance and representing some of the most pressing problems facing the military medical authorities. The association leaders seem to have been concerned with stressing the fact that the armed forces were applying such definitions as "combat fatigue" to real neuropsychiatric problems, and were perturbed by the fact that there had been a certain schism in the liaison between the non-medical branches of the armed forces and the medical branches. For example, there was always a certain amount of hesitancy to say that a soldier or a sailor was suffering from a mental disorder, and it seemed that the effort not to hurt the feelings of the line officers primarily, and the patient secondarily, often limited the military psychiatrist's job to that of a diplomat who had to salve the feelings of those who were irked by the truth.

Included in the papers are several excellent neuropathological projects. The paper by George M. Hass on cranio-cerebral injuries of personnel involved in aircraft accidents is most illuminating and instructive. The electroencephalograph contribution is more than adequately handled by Ephraim Roseman and Barnes Woodhall, who write on that most interesting and perplexing problem, the incidence of post-traumatic epilepsy. Lawrence Kubie and S. Margolin contribute one of the better controlled research projects: on the therapeutic role of drugs in the processes of repression, dissociation, and syntheses. Grinker's sodium pentothal abreaction treatment is adequately discussed.

In concluding, it can be said that this compilation represents the efforts of the leaders in the fields of neuropsychiatry to synthesize and put into action the combined knowledge of military and civilian scientists so that there will be a certain amount of liaison in the

handling of neuropsychiatric casualties and further that the beneficiaries of scientific thought, the men on the fighting fronts, will profit thereby and be better soldiers in a war and better citizens on the return from war.

ROBERT MAZER



PSYCHIATRY FOR SOCIAL WORKERS.

By Lawson G. Lowrey. *Columbia University Press, New York*. \$3.50. xii + 337 pp. 1946.

This book is well-named. It gives in a single volume a discussion of mental disorders in a fashion which is both understandable and usable for social workers. It is evident that Lowrey has a fine conception of the problems which the social worker must meet in her everyday job. He has succeeded in presenting his discussion of mental illness in such a way that the social worker can profit by it in her contacts with clients and their problems.

It is made clear by the author that he is not attempting to have his book serve as a textbook on psychiatric disorders but rather to give social workers some understanding of what to look for in the behavior of persons which will mark them as needing psychiatric help. He has clearly distinguished the types of situations in which the social worker can safely work alone with a client from the situations in which she needs to seek the aid of a psychiatrist for the client. The social worker is warned against attempting to give treatment for which she has not been trained. At the same time it is recognized that the social worker can be of great value in the treatment of patients when she knows her function and limitations. Of particular value to those social workers concerned with children's problems are the chapters on behavior disorders. Clear statements are made regarding the most common behavior problems found in children and explanations are given of their meaning to the child and to the adults surrounding him.

Lowrey has accomplished in this book the goal which he expressed in the preface, namely, "to present the indicator symptoms of deviation in mental functioning, with special reference to differential symptom pictures which help the social worker in her task of reaching some conclusions with respect to the types of situations in which she needs expert advice, when special types of placement or treatment are necessary, or where she may safely undertake supervision or a treatment plan of her own."

HELEN HEWITT ARTHUR



MODERN CLINICAL PSYCHOLOGY. *McGraw-Hill Publications in Psychology*.

By T. W. Richards. *McGraw-Hill Book Company,*

New York and London. \$3.50. xii + 331 pp. 1946.

The objective of this book, as stated in the preface, is to improve the intuitive capacity of the student of psychology. To accomplish this praiseworthy but questionably feasible objective, the organization follows a definite scheme, which has some advantages for the reader, but is most confusing in any attempt to follow the treatment of a specific topic. For example, the Rorschach test is discussed—and in a different connection each time—in no less than sixteen different places in the text, at sufficient length to justify inclusion in the index. This makes also for undue tautology.

The scheme of the organization, following five opening chapters orienting the reader to the specific field of clinical psychology, is a discussion of (1) appraisal of capacity, (2) appraisal of motivation, and (3) appraisal of control. As pigeonholes these topics have merits, but they appear to be bulging slightly from the author's efforts to cram a whole dynamic clinical psychology into these three slots. Illustrating the overflow are the two concluding chapters (Precipitation and Predisposition; Readjustment), constituting a refutation of the organization of the whole text. The general impression is one of flesh adhering very loosely to skeleton.

The actual discussion of clinical psychology appears to be subordinated to that of abnormal psychology. Certainly, case material is extremely valuable to illustrate theories and ideas, but much of the case content is dragged in, not very pertinently, and one wonders why so high a percentage of it has been borrowed from other texts, and almost no contribution in this area made by this book itself. There are 24 case reports listed in the index, of which all but two or three appear to be borrowed. For example, one long discussion of a homosexual (12 pages) is borrowed from Henry, and 21 pages of transcription of non-directive therapy comes from Madigan.

Despite the flaws just noted, this reviewer has tried the book as a textbook in an undergraduate course in Clinical Psychology and has found the students liking it (or saying they did), if requiring a great deal of elucidation and glossing. An appendix includes a list of the nomenclature of mental disorders adopted by the American Psychiatric Association in 1933; a good bibliography of 148 titles documents the text, and a worthwhile addition is a list of visual aids, with sources.

ARTHUR LICHTENSTEIN



PSYCHIATRIC INTERVIEWS WITH CHILDREN.

Edited by Helen Leland Witmer. The Commonwealth Fund, New York; Geoffrey Cumberlege, Oxford University Press, London. \$4.50. x + 443 pp.; ill. 1946.

This is a very practical volume, in which a successful effort has been made to report what actually happens

with children in child guidance clinics. Helen Witmer has done an intelligent job of collecting and editing actual case reports from ten well-known therapists. She has also done an important preliminary job of introducing the reader to historical facts and contemporary concepts of child guidance. While she describes the full clinic "team" of therapist, social worker, and psychologist, her emphasis is primarily on how the psychiatrist functions in this setting and with what type of patient. The last two chapters of her introductory section, which deal respectively with the selection of patients and the dynamics of the therapeutic relationship, are particularly helpful.

Part II is devoted to actual case studies. The selection of material was done thoughtfully, with the idea of choosing varied but representative patient problems which were successfully handled in therapy. Each therapist, following the editor's clear but never rigid pattern of emphasis, has written up his own case. Frederick H. Allen, Phyllis Blanchard, Lydia N. G. Dawes, Hyman S. Lippman, Martha W. MacDonald, H. B. Moyle, Beata Rank, and Robert A. Young are the contributors. After a summary of the problem presented and a discussion of how treatment was visualized at the beginning of the contact, the authors report the hour by hour twists and turns of the therapeutic process within the child. The wealth of detail about the child's response and the frankness with which the psychiatrist relates his actual handling of the case gives the reader a real sense of participation. This effect of an inside view is further enhanced by running interpretive footnotes, which let the reader know how the therapist senses the case as it develops.

Despite the large number of contributors, this book has a coherence of both subject matter and style that is a real achievement. And it is never dull. It is a book which should be read by all who are doing or who intend to do psychiatric work with children. Many others, in a variety of related fields, will also enjoy and be stimulated by the volume.

HELEN HEWITT ARTHUR



THE PSYCHOANALYTIC STUDY OF THE CHILD. *Volume II, 1946. An Annual.*

Edited by Phyllis Greenacre, Heinz Hartmann, Edith B. Jackson, Ernst Kris, Lawrence S. Kubie, Bertram D. Lewin, Marian C. Putnam, Rudolph M. Loewenstein, René A. Spitz, Anna Freud, Willie Hoffer, and Edward Glover. International Universities Press, New York. \$7.50. 424 pp. 1947.

This is the second volume of the projected annual publication of significant psychoanalytic papers dealing with child problems. Again one is impressed with the sincerity and seriousness with which the editors have selected the material. It is also impressive how much a

common theoretical approach unifies a book actually written by twenty individualistic authors.

The papers are loosely grouped under five headings. The first section, Problems in Child Development, is comprised of six papers which vary greatly in length and reability. Jeanne Lampl de Groot has a stimulating paper here on The Pre-oedipal Phase in the Development of the Male Child. She calls attention to a period of female identification which boys commonly go through prior to the Oedipal phase and suggests that this developmental experience may explain certain aspects of adult maladjustment.

Part II, by far the most interesting section, contains eleven fascinating studies on Clinical Problems. Infantile feeding disturbances, psychogenic tics, reading disabilities, enuresis, and childhood psychoses are some of the entities discussed dynamically by such well-known analysts as Anna Freud, Margaret Gerard, Phyllis Blanchard, to mention only a few. There is also a reprint (translation) of Waelder-Hall's classical paper, The Analysis of a Case of Night Terror, the first child analysis to be reported in detail. Originally presented in 1930, it is still a vital case study.

Parts III and IV, entitled Guidance Work, and Problems of Education and Sociology, respectively, are not very good. The three papers included, while not exactly vapid, seem verbose and their points either over-emphasized or diffused.

The last paper (under History of Child Psychiatry) is a report on J. B. Felix Descuret, a French M.D. of the last century who made some very pertinent observations of emotional reactions in his child patients.

Volume II thus includes some very excellent papers. On the whole, however, it is not quite such an effective work as Volume I, which actually set an exceedingly high standard for succeeding volumes to equal. This comparison, though, should not conceal the fact that both volumes represent real contributions to modern child psychiatry and belong in the library of those interested in that field.

HELEN HEWITT ARTHUR



MEN AND THEIR MOTIVES: *Psycho-Analytical Studies*.

By J. C. Flugel, with two essays by Ingeborg Flugel. International Universities Press, New York. \$5.00. vi + 290 pp. 1947.

This book consists of eight disparate essays, only one of which has not appeared previously in either *The British Journal of Medical Psychology*, the *International Journal of Psychoanalysis*, or *The Psychoanalytic Quarterly*. Despite the wide variety of subject matter, however, there is a consistency of style and intellectual approach (found, indeed, even in the two papers contributed by the author's wife) which produces a feeling of unity within the entire work. Probably the fact that Flugel

adheres in each paper to a systematic development of the unconscious motives involved accounts for the surprising coherence of this volume. Such a series of studies points up the real relationship between all unconscious motivations whatsoever, whether they are concerned with current attitudes toward birth control, the international language movement, or the character and married life of Henry VIII—all issues dealt with in the book. In addition to these subjects, Flugel makes learned and searching observations on Sexual and Social Sentiments, Some Problems of Jealousy, and on a train of thought provoked by Maurice Bedel's book *Jerome*.

There is no doubt that Flugel exemplifies the highest type of scholarly and, at the same time, original thinker. The fact that his thinking is oriented toward psychoanalysis is a tribute to that field. While his writing, dealing as it does with many abstract concepts, does not make for facile reading, it is logical. There are real rewards for the intelligent student who will take the time to follow the author's thoughts to their conclusions.

Flugel's work has long been regarded as a classical contribution to psychoanalytic thinking. In fact, the papers in this volume were first published by a London house in 1934. It has remained for the recently expanded interest in psychoanalysis in this country to make the book available here. Despite the lapse of time, however, there is nothing dated about the material. It remains as provocative, as constructive, and as currently applicable as when it was first published. Perhaps it is even more valuable, now that psychiatry as a whole is more receptive to the concept of unconscious motivations.

HELEN HEWITT ARTHUR



HYPNOTISM TODAY.

By Leslie M. LeCron and Jean Bordeaux. Foreword by Milton H. Erickson. Grune & Stratton, New York. \$4.00. x + 278 pp. 1947.

This is a well rounded and practical discussion of hypnotism as revealed in the current literature, illustrated by the authors' own observations. To aid in the understanding of the peculiar attitude commonly held toward hypnosis, a historical background is first presented. Methods of inducing the hypnotic state are enumerated, both in general principle and in very specific application. The major phenomena observable under hypnosis are described, and then the use of the technique in the treatment of a variety of disorders is considered. Finally, some suggestions are made regarding the orientation of future research.

The text is well documented, and the writers are generous with concrete examples from their professional practice. Thus the material strikes the reader as reasonably authoritative. However, there are a

number of characteristics, some of style and some of underlying logic, which may irritate certain readers, may lead others to adopt a cautious and tentative attitude toward the proffered interpretations, and may perhaps cause a few to discard the book completely. More than one controversial issue seems to have been settled by an a priori decision, and then any contrary evidence either vaguely explained away or disregarded altogether. Whenever the findings of Hull and Erickson come into conflict, it is safe to predict that the former experimenter will be dismissed as an amateur. Particularly distressing to the psychologist is the apparent misunderstanding and misuse of certain terms and principles of current non-hypnotic psychology.

The section on hypnotherapy, although spread thinly over too many pages, should be challenging to a wide audience—physicians, physiologists, psychologists. There appears to be abundant demonstration that a considerable variety of human ills, not only of so-called functional origin but also of organic nature, can be relieved during the trance state. The hypnotized patient must first be persuaded to accept the faith that the treatment will be successful, at the same time developing a genuine desire to be cured. Next, incessant suggestion is given that the symptoms will disappear. In cases with emotional involvement, the therapist must lead the patient toward increased insight into the etiological dynamics of the situation. And finally, help must be given in the building up of new and healthy habits of thought.

It should perhaps be said that some of the theoretical discussions of LeCron and Bordeaux are open to argument, and that critical judgment must be exercised in their evaluation. But it is equally true that the data submitted are well worth examination if an adequate conception of the present status and future possibilities of hypnotism is desired.

FRANK W. FINGER



THE PERSONALITY OF MAN: *New Facts and Their Significance*. Pelican Books.

By G. N. M. Tyrrell. Penguin Books, Harmondsworth, Middlesex. 1s. (paper). 295 pp. 1946.

Before the average reader finishes this book, he may suspect that by some queer accident of publishing the content and title of two different volumes have been shuffled, and that somewhere a comprehensive treatise on personality must be skulking along under the alias of *Psychical Research as an Antidote to Materialism*. Certainly he will be disappointed if he expects to find in *The Personality of Man* an analysis of the subject defined by Allport in his *Personality*, or by other American psychologists in their briefer textbook discussions.

The motivation of this book seems to stem from the conviction that all is not well with the world, and that the root of the evil is a materialism fostered by a blind

faith in modern science—or in modern scientists. In search of a substitute, Tyrrell turns to so-called parapsychology, which is depicted as furnishing proof of a nature and destiny of human individuals presently invisible to established science. Inspiration and genius, mysticism, telepathy, and foreknowledge are considered in terms of anecdote and laboratory study. The hesitation of the majority of scientifically inclined psychologists to accept the implications of parapsychological experiments is appraised in the light of the scientific method itself, and is dismissed as being an emotional shrinking from the unfamiliar. The conclusion is reached that parapsychology, as it takes us into the realm of the unknown, opens up the philosophical possibility that materialism must be repudiated, and that life may be worth living, after all.

That the present state of human society leaves something to be desired will probably be accepted with little argument. A number of alternatives have been suggested as possible remedies: a moratorium on physical science, an acceleration of the scientific study of social problems, a deeper acceptance of some religious or philosophical schema, a revision of the economic system, a broadening and vitalizing of the educational process. The reasons for adding to this list the endowment of laboratories for parapsychological research are interesting, but the speculation is short of convincing. It is a long leap from card-guessing and cross-correspondence puzzles to an improved private or international morality.

FRANK W. FINGER



PSYCHIC SCIENCE AND SURVIVAL.

By Hereward Carrington. The Beechhurst Press, New York. \$2.50. 142 pp. 1947.

The thesis of this popularly written book is that psychic science is the only hope for the survival of the church, that it furnishes the only evidence for the reality of the soul, and that it provides the only satisfactory basis on which a meaningful Cosmic philosophy can be built. There is no systematic argument regarding the validity of psychic phenomena. Rather, Carrington presents two lists: "scientifically proved" are telepathy, clairvoyance, psychometry, apparitions, dowsing, telekinesis, psychic raps, and psychic lights; "so nearly established as to constitute virtual proof" characterizes premonitions, haunted houses, the astral body, psychic powers of animals, materialization, levitation of the human body, and spirit communications. In the light of these demonstrations, a superphysical world must be admitted to exist, and the most logical explanatory theory is that the personality survives in some form after the death of the body.

For one seeking a scientific evaluation of the evidence for "super-normal phenomena," further sources must be consulted. But here may be examined some sug-

gestive implications of these phenomena,—if they are real,—implications of considerable import both to the individual and to science itself. At the same time, the reader may be interested in the analysis by this psychic researcher of the reasons why so many conventional scientists scoff at the evidence. And between the lines there may perhaps be detected certain opposing and equally insidious motivations that predispose other individuals to embrace the “superphysical” interpretation.

FRANK W. FINGER



HUMAN BIOLOGY

SOCIOLOGY. *McGraw-Hill Publications in Sociology.*

By Richard T. LaPiere. *McGraw-Hill Book Company, New York and London.* \$3.75. xvi + 572 pp. 1946.

SOCIETY IN THE MAKING.

By M. N. Chatterjee. J. W. Edwards, Ann Arbor. \$2.00 (paper). x + 190 pp. 1946.

Sociology is the youngest of the sciences. Although attempts have been made to integrate and systematize the observations that man has made on his own gregarious nature, the results of these attempts have not always proved satisfactory. Most sociologists of the past have failed to recognize that sociology is in reality a branch of biology and that any system of sociology which lacks a biological foundation is like the house built upon the sand.

Furthermore, in sociology, like psychology, the observed object is also the observing subject. Most of the natural sciences have developed from man's contemplation of the environment about him, and this environment is not changed by the contemplation. But when man contemplates himself he develops himself. It follows that man's sociological evolution must be more complex than his organic evolution, for the latter has been brought about by the interaction of only two sets of factors, over neither of which he exercises conscious control: his heredity, derived from the past, and his environment which is in the present. But his sociological evolution involves a third set of factors: his behavior. This is largely teleological, being consciously shaped to bring about a desired end, and so belongs to the future.

To the reviewer the presence of teleological factors in evolution appears to be an essential, though not necessarily a sufficient, condition for the establishment of a normative science. The fundamental difference between the two works covered by this review is that one develops a descriptive, and the other a normative, science. The first seeks to answer the question, How does man actually live among his fellow men? and the

second, How ought man to live among his fellow men?

Both writers seem to be adequately grounded in those biological fundamentals which are a prerequisite to the erection of a superstructure of sociology, and they both have the ability to express themselves lucidly for the reader of average intelligence—an ability too often lacking in the leaders of modern scientific thought. Because these two authors approach their subject matter from different vantage points, their works are complementary. The student who reads them conjointly will get a stereoscopic view of human relations that cannot be achieved by reading them separately. In this case the whole is greater than the sum of its parts.



AN INTRODUCTION TO SOCIAL BIOLOGY.

By Alan Dale. William Heinemann, Medical Books, London. 15s. viii + 396 pp.; ill. 1946.

Textbooks of so-called human biology have appeared before, but this is the first I have seen really to deserve the name. It is the most original and interesting presentation I have met with. Prepared for the Sixth Form of a large boys' secondary school, it compares favorably with American college textbooks for beginning courses in biology. Well printed on excellent paper, its half-tone illustrations achieve a clarity and contrast all too rare in elementary textbooks.

The treatment of the subject begins with a consideration of Life in Space and Time and proceeds to Man and Evolution. The third chapter, headed Man as an Animal, surveys very concisely the anatomy and physiology of the human being and stresses the study of behavior. The next three chapters form a unit on the maintenance of the human species, dealing (a) with Sex, (b) with Inheritance, and (c) with Reproduction. Comparative aspects are not neglected. Two chapters on Man and His Health follow: (a) on Social Hygiene, (b) on the History of Medicine. These are very well done. The remaining chapters cover the subjects of Food and Drink, The Balance of Nature, Social Life Among the Animals, Some Reasons for Man's Success, and The Nature of Life. Suggestions for further reading and an index complete the volume.

There are, of course, minor errors. These are remarkably few in comparison with those in most first editions of college biology textbooks, however—while the superb originality of organization and treatment would atone for many more than actually exist. The discussions are meaty and thought-provoking. A fine grasp of the historical development and significance of science is met throughout. The book, small in comparison with most college and high school biology textbooks, far outweighs them in social and educational significance. It should have the widest encouragement.

BENTLEY GLASS

WOMEN IN INDUSTRY: Their Health and Efficiency. Issued under the auspices of the Division of Medical Sciences and the Division of Engineering and Industrial Research of the National Research Council. Prepared in the Army Industrial Hygiene Laboratory.

By Anna M. Baeljer. W. B. Saunders Company, Philadelphia and London. \$4.00. xii + 344 pp. 1946.

This is a carefully prepared, analytical review of the available information, and particularly that gained from war-time experiences, relating to the health and efficiency of women employed in industry. The main body of the book consists of six sections. The first of these deals with the ability of women to perform work and with the types and conditions of work, including placement policies. This section is followed by discussions of sickness and absenteeism, accidental injuries, and occupational diseases, and comparisons are made with the same or similar conditions occurring among males. The relation of gynecological and obstetrical problems and of fertility and mortality to occupation is then considered in some detail. The text is completed with ten pages that summarize the material of all six parts. The appendices contain a good deal of data concerning the numbers of gainfully employed women, the suitability of occupations, and relevant legislation. There is an extensive bibliography.

This work is a unique and timely contribution to the literature of industrial hygiene and will undoubtedly be a valuable reference book for those interested in public health. In addition, it is well worth consideration for general reading, for it is a thoroughgoing presentation of a subject of increasing importance.

HARRIETTE D. VERA



THE PHILOSOPHY OF WAR AND PEACE.

By Albert C. Knudson. Abingdon-Cokesbury Press, New York and Nashville. \$2.00. 221 pp. 1947.

This book lives up to its name well. It is the best exposition of the philosophies of war and peace the reviewer has ever read. The author is not a pacifist, a fact which lends great weight to the book. The pacifist, like the militarist, is committed in advance to the support of his theories, for which reason one is compelled to discount all discussion of either pacifist or militarist doctrine as propaganda. But the arguments of a writer who is not committed to saving his face cannot be dismissed so readily. In his preface the author states that he has sought to be objective and dispassionate, and that therefore he expects to satisfy neither the thoroughgoing militarist nor the absolute pacifist. Yet just because he has succeeded in being so objective and dispassionate, the pacifist is likely to obtain far more aid and comfort from his work than the militarist.

This is due partly to the fact that the author's thought seems much keener in his analysis of the philosophy of peace than in that of war, but it is due chiefly to the fact that the famous peace plans of history have been the work of men whose mental calibre, as a group, was superior to that of the apologists for war.

The author discusses in detail fourteen different plans to insure international peace, beginning with *De Monarchia* by Dante Alighieri and published sometime prior to 1321, and ending with the *Institutes of the Law of Nations* by James Lorimer, published in 1884. Against these, the only writer who seems to have published anything on the other side is the infamous Machiavelli. Even such militaristic writers as Treitschke, Nietzsche, and Hegel did not seek to establish warfare as a permanently enduring international condition, but only to justify recourse to it in preference to more peaceable methods of settling international differences.

In his opening chapter the author has considered various attempts to rationalize warfare, and it is interesting to note that, while he makes no attempt to demolish the arguments of the peace planners, he demolishes very effectively every argument advanced by those who advocate recourse to war. He merely suggests that the peace plans have not succeeded because they have not been tried—surely a sane and reasonable statement. If the nations would spend on peace only a small fraction of the money, activity, and cerebration which they are now expending to pay for old wars and to prepare for new ones, there would be "no need for arsenals or forts."

The book appears to have a few weak points. The omission of any reference to Jonathan Dymond's famous essay is one of them. Another is the author's belief that war goes back to the beginning of the human race. The fact that there is nothing resembling war among the anthropoid apes makes it seem more likely that man was originally a peaceable animal who acquired militarism in the course of his social evolution. While this point is of little importance, the next one is not. The author states that "the considered moral judgment of mankind recognizes no fundamental difference between the coercion exercised by the police force and that exercised by the army." This statement seems completely fallacious, since the functions of the army and the police are diametrically opposed. To realize that this must inevitably be the case one need only recall the statement, attributed to an officer of the national guard in criticising the delegation of that organization to police the border in 1916, that military training unfitted men for police service, or to remember that when a recent unsuccessful presidential candidate was said to have suggested the use of the army as a domestic police force, he was promptly rebuked on the ground that such a plan would be unconstitutional. The fundamental difference between the use of coercion

by the army and by the police was elucidated a few years ago in a pamphlet distributed by the Fellowship of Reconciliation, and written by C. J. Cadoux. It is unfortunate that this item was overlooked when the voluminous and enlightening bibliography was compiled. The difference is, of course, that the function of the army is to participate in a controversy, while that of the police is to maintain order. The one is like a pugilist in the ring, the other like the referee. The one says, "My country, right or wrong," and the other says, "May the best man win." The battlefield never decided which of two nations was in the right, but only which was the stronger.

The blurb on the cover states that this work is a clear, compact, introductory study of a question that may be the most vital of all time, and recommends its use among churches, clubs, and small groups. With this sentiment there must be complete accord.



THE JEWISH PEOPLE: *Past and Present. Volume 1. Jewish Encyclopedic Handbooks, Central Yiddish Culture Organization (CYCO), New York.* \$10.00. xvi + 430 pp. + 9 plates; text ill. 1946.

To anthropologists, ethnologists, and biologists interested in the origins and mixtures of human races and peoples, this volume will offer considerable matter for thought. The first article is a contribution by M. F. Ashley Montagu on Race Theory in the Light of Modern Science, in which he reiterates his well-known critique of racial theory regarding man. In short, following Dobzhansky's definition of race, he would discard the concept as quite inapplicable to man, and substitute for it the term "ethnic group," meaning thereby one of a number of human populations which individually maintain their differences, physical and cultural, by means of isolating mechanisms such as geographic and social barriers. These vary in strength from place to place and time to time and so permit the intergrading and hybridization of the ethnic groups. Measured by this concept, the Jews are to be classed not as a single ethnic group, nor even as several, but as members of a common culture. The second contribution to the volume, *The Anthropology of the Jewish People* (J. D. Bretzkus) supports this judgment with evidence of the diversity of the Jews in anatomical and physiological characteristics, physiognomy, gestures, etc. The blood group comparisons are particularly convincing. Jews from different parts of Europe show a great diversity in the frequency of specific blood types, whereas highly inbred "isolates," such as the gypsies or the Germans of Hungary still closely resemble after many centuries the peoples of their respective origins in their blood group frequencies. There are two basic types of Jews, the Oriental and the Western Asiatic; but through centuries of migration

and intermixture with other peoples, the European Jews are best classed (geographically) as (1) the Jews of the Mediterranean countries; (2) the Jews of Western Europe; (3) the Judaeo-Khazar groups in the Crimea, Caucasus, and Central Asia; and (4) the Eastern European Jews of Poland, Lithuania, Russia, and Romania.

The history of the Jewish people, both archeological and written, is outlined by Wm. F. Albright, E. L. Sukenik, A. Menes, and A. Steinberg. The major portion of the volume, following these contributions, is then filled with studies of the Jewish religion. At the end of the book, along with some reviews of the economic and social development of the Jewish people, there are two further contributions of biological interest: *The Jewish Population of the World* (Arthur Luppin), and *Jewish Migrations During the Last Hundred Years* (L. Hersh). In 1939 the population of Jews was reckoned at 9,462,000 in Europe; 5,556,000 in North and South America; 1,008,000 in Asia; 594,000 in Africa; and 28,000 in Australia and New Zealand; a total of 16,648,000. 4,870,000 of these (33.4%) lived in the United States of America. The great emigrations to the U. S. and in recent years to Palestine are fully recorded.

The book is well printed and superbly illustrated, including a number of color plates; but the binding is none too substantial.

BENTLEY GLASS



PALESTINE: *Land of Promise. Revised Edition.*

By Walter Clay Lowdermilk. Harper & Brothers, New York and London. \$2.50. xii + 244 pp. + 16 plates. 1944.

The dark green citrus groves with their red tile-roofed white residences and farm buildings, and the dazzlingly white modern Jewish towns scattered over an otherwise drear and depressing stony landscape made a great impression upon the author, as they do upon every traveller by air who comes upon Palestine after crossing the wastes of the Syrian desert.

Since ancient times Palestine has been the corridor between important centers of population and civilizations. And it continues to be in the tension zone between powerful nations, and between the nomadic tribes of the desert and the settled tillers of the soil and their associated artisans. Considerable space is given to describing the unusual collective agricultural and industrial colonies, and to showing that in spite of the urban and white-collar background of many of the colonists, they have been remarkably successful in developing productive and going enterprises in Palestine.

This beautifully printed book is especially helpful now that the questions of the rights, privileges, and

obligations of the Jews and the Arabs are being debated in the press and in the United Nations. The author claims that the Arabs individually and in their village life and agricultural practices have benefited markedly as a consequence of the development of Palestine by the Jews, and that this is shown by public health and economic conditions. By contrast, the influential Arab landlords and politically minded leaders are the ones who so strongly oppose an increase in the number or influence of the Jews in Palestine.

The author's original proposal for a "Jordan Valley Authority" seemed visionary. He had suggested that the waters of the Jordan and other streams should be used more effectively for irrigation and land reclamation; and further, that the waters of the Mediterranean should be brought through the mountains in tunnels and used for the development of electric power by the fall of over 1200 ft. down to the level of the Dead Sea. This would also maintain the level of that lake at approximately its present position and make possible the continued exploitation of the dissolved salts in its water. However, this new edition includes a chapter summarizing essential features of the report of an engineering board appointed to study the possibilities of this "authority." It appears that the engineers are even more optimistic over the project than was the author.

In discussing the absorptive capacity of Palestine, the author states that during the past 25 years not only have almost half a million Jews been settled in the country, but that the Arab population has doubled. As to the future, with the full utilization of the "authority" for reclamation and power, it is considered possible to absorb at least 4 million Jewish refugees from Europe in addition to the 1,800,000 Arabs and Jews already in Palestine and Trans-Jordan. "On 14 per cent of the cultivated area and 6 per cent of the total area of Mandated Palestine, a people with faith and devotion born of long tradition has changed desolation into fertile fields, fruitful orchards and reforested slopes. Ancient cities have been rebuilt and the commerce of their streets quickened, long-unknown resources have been brought into the light of day and sent to the distant marts of the world. After the centuries of darkness which crushed the hopes of Palestine's miserable inhabitants, a new force has come into the land and made it live again. The possibility of a new day for the entire Near East is hidden in the fertile lands, the flourishing villages and cities, the co-operatives and the factories of Jewish Palestine. If the forces of reclamation and progress Jewish settlers have introduced are permitted to continue, Palestine may well be the haven that will transform the other lands of the Near East. Once the great undeveloped resources of these countries are properly exploited, twenty to thirty million people may live decent and prosperous lives where a few million now struggle for a

bare existence. Palestine can serve as the example, the demonstration, the lever, that will lift the entire Near East from its present desolate condition to a dignified place in a free world."

ROBERT L. PENDLETON



ANTI-SEMITISM: *A Social Disease.*

Edited by Ernst Simmel, with a preface by Gordon W. Allport. International Universities Press, New York. \$2.50. xxviii + 140 pp. 1946.

This extremely well written compilation represents another effort by the psychoanalytical movement to explain—at least to its own satisfaction—the rather well worked-over problem of anti-Semitism. A glance at the little biographical sketches about the authors indicates that there is no lack of properly trained analysts and sociologists in the group that made the contributions; included are: Otto Fenichel, Douglas Orr, B. Berliner, Ernst Simmel, T. W. Adorno, Gordon W. Allport, and Max Horkeimer.

This work received impetus from the Nazi persecutions, which were to the student of anti-Semitism like waving the traditional red flag before a bull. A current incentive to read the book is the turmoil in Palestine, which is nurturing another wave of anti-Semitism. This collection originated from a symposium on the subject arranged by the San Francisco Analytical Society because "we considered it our duty to the immediate community—as well as to the larger community of the world—to submit the problem of anti-Semitism to the scrutiny of unbiased science." The symposium met in San Francisco in 1944, and the book is the result of the discussions, well edited by Ernst Simmel.

Considering what prejudice is, the problem was posed, as one reads the book: "How many individuals do examine their opinions?" *Anti-Semitism* paints a vivid picture of the dynamics to be discerned through the glass of psychoanalysis. Such pertinent factors as the repressed lust to kill, the love of dirt, and low voluptuousness are kept hidden in the unconscious but strive to get out into the open, and therefore, can be projected upon the Jew. At the basis of the individual obsessional ideations of anti-Semitism is the latent homosexual complex.

The section on mass psychopathology is well handled. It is shown how in a mob one can use mob psychosis as an excuse for the breakdown of the individual ego. Mob psychosis also offers an approach to the understanding of the mental defense mechanisms against the recognition of one's own guilt. Orr, who wrote this section brilliantly, elucidates many of the Jewish customs which have been seized upon by racially prejudiced people. He works out well, in an analytic sense, the Jewish custom of eating a freshly killed lamb on

Passover, and how the lamb is taken to represent the devouring by the Jews of the lamb-like Christ. He interprets Hitler's desire for a pure Aryan race as an unconscious perception that basic human hatred drives people to desire to incorporate each other by devouring.

The results of the Rorschach and the Thematic Apperception Test on known anti-Semitic personalities among college students revealed principally that such persons are insecure people, afraid of losing their social status. This serves to release their inhibitions and to cause them to act like Jews, and so further to jeopardize their social standing. Anti-Semitism is for them a method to maintain their identification with the middle class and so to avoid anxiety.

Emotional security, self understanding, and maturity are offered as antidotes to the trend. The question arises: How can such an immense program be started and accomplished? It is an accepted fact that anti-Semitism has its origin in childhood, when a child identifies himself with the attitudes of his parents, and refuses to allocate his hate, developing a prejudice against all Jews because some little Jewish child would not lend him some toys, or beat him up in a fight. Cooperation would be received only from those who have little or no racial bias already.

To conclude: *Anti-Semitism* is well written and replete with theories acceptable in most psychoanalytical circles, and it can be read with understanding by those who have a psychoanalytical orientation and can derive something from the book to support their own conclusions.

ROBERT MAZER



ZENTRALEUROPA'S ALPWIRTSCHAFT. *Volumes I and II. Institutet for Sammenlignende Kulturforskning, Series B, XXXVIII.*

By John Frødin. H. Aschehoug & Co. (W. Nygaard), Oslo; Kegan Paul, Trench, Trubner & Co., London; Otto Harrassowitz, Leipzig; Société d'Édition "Les Belles Lettres," Paris; Harvard University Press, Cambridge. (I) N. Kr. 20.00; (paper) N. Kr. 15.00. (II) N. Kr. 25.00; (paper) N. Kr. 20.00. (I) xxx + 411 pp.; ill. (II) viii + 583 pp.; ill. (I) 1940; (II) 1941.

Europe's dairy industry, unlike ours, is situated primarily in mountainous regions and is connected with a very old economic set-up, the so-called "Alp" or "Senn" economy. The "Alp" is a settlement in the high mountains, inhabited by man and livestock only in summer and therefore assimilated to semi-nomadic forms. John Frødin, who had earlier studied these establishments in his native Scandinavia, has now concentrated in this monumental work the experience and results of two decades of fieldwork in Central Europe, surveying simultaneously an extensive litera-

ture on the subject. The book deals with the "Alps" in the Giant mountains of Silesia, the Black Forest, the Vosges, the Swiss Jura and Alps, the French Alps, and the Eastern Alps, divided politically between Austria, Italy, and Yugoslavia.

The starting point for the author is in every case the geographic situation, which has created and modified this particular economy. But all other aspects—technical ones like the different forms of migration and settlement, the kinds of animals cultivated, the kinds of product (milk or meat) envisaged, as well as such economic-social aspects as the different forms of ownership (communal or individual), size of enterprise, etc.—are most carefully examined.

It is impossible to do justice to this classic of human geography in a short review. But special mention should at least be made of the more than two hundred illustrations, all collected by the author himself, that form an integral and not the least valuable part of an invaluable book.

ERWIN H. ACKERKNECHT



THE BANTU TRIBES OF SOUTH AFRICA: *Reproductions of Photographic Studies. Volume III, Section IV, The Nguni: Section IV, The Swazi. With an Introductory Article on the Swazi and Descriptive Notes on the Plates.*

By A. M. Duggan-Cronin; introductory article and notes by Hilda Beemer. Deighton, Bell & Co., Cambridge, Eng.; Alexander McGregor Memorial Museum, Kimberley. 25 s. (paper). 32 pp. + 32 plates. 1941.

This monograph on the Swazi makes part of a many-volume iconography of the Bantu tribes of South Africa. The 32 pages of text are very interesting and substantial, giving a short outline of the colorful history of the tribe; the peculiarities of its feudal political structure, wherein power is divided between the king-mother and the king; its economy; its (polygynous) family life; its age hierarchy; and acculturation problems. The 32 plates are excellent, yet insufficient in scope and too statutory to give a real impression of tribal life.

ERWIN H. ACKERKNECHT



INDIANS BEFORE COLUMBUS: *Twenty Thousand Years of North American History Revealed by Archeology. A Contribution of the Chicago Natural History Museum.*

By Paul S. Martin, George I. Quimby, and Donald Collier. The University of Chicago Press, Chicago. \$6.00. xxiv + 582 pp. + 1 plate; text ill. 1947.

The authors state that this book was written for the interested layman and for students taking introductory

courses in anthropology and that it is not intended as a general reference book for professional anthropologists. The form of the book, however, is much more like that of a reference book. It is systematic, factual, and extremely compressed. Archeology is defined, and the origin of the American Indians is discussed in a section called Background. There are sections on Arts and Industries, The Earliest Indians, The Southwest, Eastern North America, The Pacific Slope, The Far North, and a concluding chapter on Chronology and Correlation of Sequences of Cultures. The work makes a fairly handy reference, but is very dull reading. This is due to compression and the shoals of facts. It is added to by the almost catechism-like style. As an example: "Did the evolution of our modern corn varieties require a long time? No, it did not."

One is made a bit uneasy about the book by the lack of specific citation of papers and the quite arbitrary inclusion or omission of papers. In short, the book suffers from having undertaken too much, and from having presented it too didactically.

GEORGE F. CARTER



ALASKA BECKONS.

By Marius Barbeau; illustrated by Arthur Price. The Caxton Printers, Caldwell, Idaho; The Macmillan Company of Canada. \$4.50. 343 pp. + 1 plate; text ill. 1947.

This handsome book can be recommended as good reading. The author is a long-time student of the Indian peoples of Alaska and adjacent Canada. In his book, he has brought together many of the myths of these Indians and has told them well. In Barbeau's hands these myths become the records of the movements of peoples from Siberia into America and their persistent seeking of better lands to the south. The work is interpretive, imaginative, and often poetic. Yet underlying it is a wealth of knowledge of the native peoples of this area. The book is illustrated with striking woodcuts done in the native style of the Northwest Coast Indians.

GEORGE F. CARTER



MAN IN NORTHEASTERN NORTH AMERICA. *Papers of the Robert S. Peabody Foundation for Archaeology, Volume Three.*

Edited by Frederick Johnson. The Robert S. Peabody Foundation for Archaeology, Phillips Academy, Andover, Massachusetts. \$2.00 (paper). xii + 347 pp. + 1 plate + 2 charts; text ill. 1946.

This volume is the result of collecting a group of papers by specialists in the area. It has the usual virtues and shortcomings of such collections. Some of the papers are highly specialized, some quite general, some

long, some short, and depending on the interest of the reader, some are uninteresting and some stimulating. In general, it is a useful collection that brings together much material and makes available in one volume a rather good over-all survey of the status of the problem of man in northeastern America.

The subjects treated are: the environment, archeology, physical anthropology, linguistics, psychology, mythology, general culture. Among the more interesting papers are W. W. Howells' treatment of physical types, A. I. Hallowell's treatment of psychology, and John M. Cooper's reconstructive interpretation of the culture of the Northeast.

Howells points to the general validity of the earlier studies that established this area as one characterized by a long-headed population. He points out that it is possible to divide the area into two slightly differing populations; that there are some islands of round-headedness; and points to the general American succession of long heads to round heads. Hallowell has done a most interesting job of using the Jesuit relations and other early descriptions of the Indians to make an analysis of their psychology. One of the interesting outcomes of this is a most reasonable explanation of the action of the Indians when drunk. Their actions are explained as the result of the liquor releasing a severely repressed person. Cooper's reconstruction of the culture of the Northeastern Indians is of interest for its world-wide view and great historical depth. He particularly examines the theoretical sequence from ice-hunting to snowshoe hunting and finds the evidence that the ice-hunting stage is the earlier is unsatisfactory. The other papers are generally less biological and more specialized.

GEORGE F. CARTER



THE LAST TREK OF THE INDIANS.

By Grant Foreman. University of Chicago Press, Chicago. \$4.00. 382 pp. + 1 plate + 8 maps. 1946.

Every history of the United States that has ever been written has come from the pen of a Caucasian writer. The Indians' side of the story has never been told and never can be. Even though the historian is actuated by a desire to present the facts truthfully and impartially, and even though he may recognize the treatment of the American aborigines as the greatest disgrace in our national history, he cannot think as an Indian and look through his eyes.

In Latin America generally, the assimilation of the races is being brought about by the fusion of the two cultures, but north of the Great River the exotic culture is rapidly obliterating the native one. Although the North American Indian is increasing numerically, he is at the same time ceasing to be Indian.

The author of the present work is an attorney who was formerly employed by the Dawes Commission to classify the lands of the Indians in Oklahoma, and who became so interested in them that he undertook to recapture their own story before it was lost forever. The volume is not pleasant reading. The dishonesty of the white settlers in stealing the Indians' livestock and raiding their crops, the cupidity of the predatory traders who supplied the Indians with fire-arms and fire-water and infected them with smallpox, the incompetence of the agents to assume the responsibility vested in them to safeguard the interests of their wards, and the indifference of the authorities in Washington as to whether the contracts entered into by Congress were ever carried out or not, all add up to make the story of the evictions the greatest stain on our national honor, and one that cannot be erased by the reforms that have been initiated during the earlier years of the present century.

The first attempt to correct the mismanagement of Indian affairs came during the administration of President Grant, and expressed itself in the establishment of the Board of Indian Commissioners, "a body of persons of standing and influence, who served without pay as observers, conscience, advisers to the President and the Office of Indian Affairs." The reviewer is the great-grandson of the chairman of this board, and he imagines that he can recognize some of his ancestor's writing in the reports of the Commissioner of Indian Affairs quoted in this work.

While the book lacks the emotionalism that characterized Helen Hunt Jackson's *A Century of Dishonor*, it tells the same story, and one may hope it will be as widely read. In view of the revelations made by the recent investigation of the Navajo Indians in Arizona, made jointly by the Indian Rights Association and the Phelps-Stokes Foundation, this book dealing with the Oklahoma Indians is very timely.



THE PUEBLO INDIANS OF SAN ILDEFONSO: *A Changing Culture. Number 34 in the Columbia University Contributions to Anthropology.*

By William Whitman, 3rd. Columbia University Press, New York. \$2.75. x + 164 pp. 1947. San Ildefonso is a small Indian village (56 adults), located 22 miles northwest of Santa Fe, that has become more widely known in recent times for the pottery which its women produce for tourist consumption. In this monograph we encounter the familiar Pueblo atmosphere of intensive religiousness, suppression of all overt aggression, and yet of factional strife and suspicion. The author was especially interested in child behavior. I have not the impression that he found anything particularly new or interesting for those beyond the circle of Pueblo specialists.

ERWIN H. ACKERKNECHT

THE INDIANS OF LOUISIANA. *University Social Studies Series.*

By Fred B. Kniffen, with illustrations by Mildred Compton. Bureau of Educational Materials, Statistics and Research, Louisiana State University and Agricultural and Mechanical College, Baton Rouge. 26 cents (paper). 110 pp.; ill. 1945.

This was written for use in the fifth grade. It is the result of the local demand for information on the Indians and on the history of Louisiana. The author is a long-time student of the Indians of that area, and he has managed to present in most readable form a concise picture of the origins of the American Indians, the coming of the Indians to Louisiana, the sequence of cultures to be found, together with a picture of the everyday life in an Indian village. It is an excellent and authoritative job. It is also lavishly illustrated with black and white drawings of blow guns, Indian designs, villages, etc. This visual aid for the comprehension of such difficult items as the spear-thrower is a valuable feature. There is appended a group of Indian myths and stories.

GEORGE F. CARTER



CHANGING KINSHIP SYSTEMS: *A Study in the Acculturation of the Creeks, Cherokee, and Choctaw. Anthropological Series, Field Museum of Natural History, Volume 33, Number 4. Publication 583.*

By Alexander Spoehr. Field Museum of Natural History, Chicago. \$1.00 (paper). Pp. 151-235; ill. 1947.

The author is able to show that the Creek, Cherokee, and Choctaw Indian tribes of the Southeastern United States had a kinship system of the Crow type, at the time when, about a hundred years ago, they were deported ("they moved," the author says euphemistically) to Oklahoma. Kinship systems changed increasingly from the old lineage to the contemporary generation pattern. These changes reflect a deep transformation of the social structure. The traditional family, built around matrilineal lineage, the clans, and the townships are all gone. The modern community is a church community. Intermarriage with whites and political and economic pressure of the latter have produced this situation.

Starting very competently in a sphere which is accessible only to specialists, the author discusses problems of increasing common interest and validity and ends his excellent study with some thought-provoking tentative generalizations.

ERWIN H. ACKERKNECHT



PAPAGO INDIAN RELIGION. *Columbia University Contributions to Anthropology, Number 33.*

By Ruth M. Underhill. Columbia University Press, New York. \$4.50. viii + 359 pp. 1946.

Ruth Underhill here continues her series of studies on the Papago. Like her other books, this one is written in easy and interesting prose. It makes fascinating reading for insight into a primitive people's religion and literature. The author has a most happy faculty of catching a people's mode of expression and converting it into English so that little of its strength and character is lost.

The material is presented under the principal headings of Communal Ceremonies, Ceremonies for Individual Power, The Use of Power, and Acculturation. Each topic is presented in terms of Papago life and is discussed in relation to the rest of the Southwest. The speeches, songs, and recitations are given in full and usually in numerous versions. There is an appendix discussing the prayer-stick festival. This ritual is of especial significance, as it seems in many of its elements to be Puebloan and non-Papago. Ruth Underhill also calls attention to the significance of the Papago creation myth, where there are sharp breaks involving the coming of alien people, together with the description of the destruction of the Great Houses (of which Casa Grande National Monument is the only survivor.) This is, then, not only a book on Papago religion. It is also a collection of primitive literature, and a valuable source book for any student of the Southwest.

GEORGE F. CARTER



THE AMERICAN INDIAN IN NORTH CAROLINA. Duke University Publications.

By Douglas L. Rights. Duke University Press, Durham, North Carolina. \$5.00. xx + 296 pp. + 111 plates + 1 map. 1947.

The author is an intelligent amateur who has for years collected material about the Indians in North Carolina. The limitation of subject is rather artificial, and the tone of the work is provincial. The bulk of the material is a "rewrite" of historical material, with copious reprinting of interesting sections. Many of the 17th century paintings of the Indians of the region, by John White, have been used for illustrations. Their reprinting is a contribution.

Books such as this are a puzzle. If one is really interested in the American Indian, he would do better to turn to original sources; if one is looking for interesting reading, he will still find better in the original sources.

GEORGE F. CARTER



A NAVAHO AUTOBIOGRAPHY. Viking Fund Publications in Anthropology, Number Eight.

By Walter Dyk. The Viking Fund, New York. \$3.00 (paper). 218 pp. + 16 plates. 1947.

This is the life story of an Old Mexican, told in his own words, and presented in chronological order, with a minimum of editing. It is fascinating reading. Anyone can read this with all the pleasure of another autobiography or, for that matter, of a good novel. It is replete with all that goes to make a good story. Humor, murder, sex, and pathos fill its pages.

But its value is far greater than its colorful and amusing qualities. It is a storehouse of information on the changing ways of life of the Navaho in the period of stress occasioned by their coming under the domination of the white man. Specialists of all sorts will mine this work for information in all lines: sex life, agriculture, food consumption, working conditions, infant mortality, primitive disease treatment, impact of diseases on a non-immune society (e.g., mumps apparently caused death within 24 hours, in some cases).

The author has annotated the work rather fully. His contribution, in addition to gathering the story and editing it, consists of these foot notes. In these he calls attention to attitudes and often gives the background and cultural motivation and setting of many of the acts of the principal character.

GEORGE F. CARTER



BIOMETRY

MATHEMATICAL METHODS OF STATISTICS. Princeton Mathematical Series.

By Harold Cramér. Princeton University Press, Princeton. \$6.00. xvi + 575 pp. 1946.

During the last 25 years British and American statisticians have been developing and amplifying the methods and techniques of statistical inference. During the same period, French and Russian mathematicians have transformed the classical calculus of probability into a rigorous and pure mathematical theory. The purpose of Cramér's book is to join these two lines of development in a presentation of the mathematical theory of modern statistical methods in so far as they are based on the concept of probability.

This is a highly technical book—one certain to have an extremely limited audience among biologists generally. It requires of its reader a fairly advanced knowledge of pure mathematics. The treatment of the material is so theoretical that the practical statistician will find little here to help him in his everyday work. But the advanced statistician who is interested in the proofs, derivations, and esoteric interrelations between many of the new sampling statistics—Fisher's *t*, the *z* transformation for correlation coefficients, χ^2 , etc.—and their sampling distributions, should find this an invaluable handbook and reference.

A. CHAPANIS

PROBIT ANALYSIS: *A Statistical Treatment of the Sigmoid Response Curve.*

By D. J. Finney, with a foreword by F. Tattersfield. Cambridge, at the University Press; The Macmillan Company, New York. \$3.75. xiv + 256 pp. 1947.

This is a textbook on the subject of biological assay as used in assessing the potency of drugs, insecticides, etc. It concerns itself almost exclusively with the case where the assay is dependent upon an all-or-nothing response. The methods of analysis developed largely by Gaddum and Bliss are considered in detail and presented in systematic form.

The book begins with certain general considerations in assay analysis. This is followed by the conventional method of probit analysis, in which the response curve is transformed into a straight line, which is then fitted free-hand or by the method of least squares. Methods for comparing the effectiveness of different preparations are adequately discussed. The author also includes a brief treatment of other methods of analyzing the assay, but does not mention the inverse sine transformation. The latter half of the book is devoted to various refinements and extensions, covering such subjects as the joint effects of two factors, mixtures of drugs, factorial experiments, etc. There is also a brief chapter on assays in which the response is graded rather than quantal.

The book concludes with a very complete bibliography of over 100 titles and a set of seven tables necessary to probit analysis, such as a table of transformations, one of weighting coefficients, one of chi-square, etc.

While this book will not be easy reading for research workers generally, it should offer no difficulty for those with some knowledge of elementary statistical procedures. There is much in it, including an appendix on the theoretical basis of the method, that will be of interest to the mathematical statistician. The book is a very valuable tool for anyone connected with assay techniques.

JOHN W. FERTIG



TABLES PREPARED BY THE MATHEMATICAL TABLES PROJECT, *National Bureau of Standards.*

The three volumes reviewed below are the latest in the excellent series of tables begun under the Mathematical Tables Project of the Works Progress Administration for the City of New York, under the sponsorship of the National Bureau of Standards. With the discontinuance of the Works Progress Administration, the sponsoring agency took over the project, under the auspices of the Applied Mathematics Panel of the National Defense Research Committee. Emphasis was placed on tables related to the war effort, with attention also devoted to the completion

of tables that had been started under the former auspices. The first two volumes reviewed are in the latter class. They were started under the Works Progress Administration, continued under the regime of the Applied Mathematics Panel, and brought to completion under the auspices of the Navy Department.

The entire project has had the cooperation of leading scientists, and the tables produced form a very valuable addition to our scientific equipment.

TABLES OF SPHERICAL BESSEL FUNCTIONS. *Volume I.*

Prepared by the Mathematical Tables Project, National Bureau of Standards. Columbia University Press, New York. \$7.50. xxviii + 375 pp. 1947.

TABLES OF SPHERICAL BESSEL FUNCTIONS. *Volume II.*

Prepared by the Mathematical Tables Project, National Bureau of Standards. Columbia University Press, New York. \$7.50. xx + 328 pp. 1947.

The functions $\sqrt{\pi/2x} J_{n+\frac{1}{2}}(x)$, known as spherical Bessel functions or Stokes functions, are tabulated. The main table in Volume I contains the functions of order $\pm(n + \frac{1}{2})$, where n has all integral values from 0 to 13, and x has values from 0 to 10 at intervals of .01, and 10 to 25 at intervals of .1. The corresponding table in Volume II contains the functions of order $\pm(n + \frac{1}{2})$ for n taking the integral values 14 to 30, and x the same values as in Volume I. Supplementary tables provide values to facilitate interpolation.

An introduction explains the nature of the functions, and a foreword discusses their application. The applications at the present time are principally in the field of wave mechanics, which includes an ever-increasing variety of problems. These include the analysis of atomic and molecular structure, the theory of nuclear disintegration, electrical oscillations in a high frequency radio tube, the diffusion of light beams, and many other phenomena. The recent developments in this field make the appearance of these tables very timely.

TABLE OF THE BESSEL FUNCTIONS $J_0(z)$ AND $J_1(z)$. *Second Edition.*

Prepared by the Mathematical Tables Project, National Bureau of Standards. Columbia University Press, New York. \$7.50. xlv + 403 pp. 1947.

This is the second edition of this volume, first published in 1943. (Reviewed Q.R.B. 19, 364. 1944.) No errors have been reported in the tables since the appearance of the first edition, and the tabular material has been reproduced from the same negatives used originally. Certain errors have been noted in the labelling of some of the graphs, and these have been corrected in the present edition. There has also been some revision in the Introduction.

The appearance of the second edition in such a short time indicates the need filled by this table.

MARGARET MERRELL

DE OMNIBUS REBUS ET QUIBUSDEM ALIIS

KUNGL. FYSIOGRAFISKA SÄLLSKAPETS I LUND FÖRHANDLINGAR. *Proceedings of the Royal Physiographic Society at Lund*, 1946. Band 16.

Gleerupska Univ.-Bokhandeln, Lund. 9 kr. (paper).

55 + 252 pp. + 3 plates; text ill. 1947.

This volume contains the following papers of a biological nature: Über die Sporenkeimung bei *Bangia* und *Porphyra* (H. Kylin); The influence of some cations on *Ulva lactuca*, and a note on its nitrogen sources (A. Kylin); On the epifauna of an anti-submarine net in the northern part of the Sound (H. Brattström); Some culture experiments with *Ulva* and artificial sea water (T. Levring); Über die Entstehung der Ruckendrüse bei *Procaria* (I. Broman); Anzahl Zellen per Raumeinheit (G. Backman); Anzahl der Beerdigten aus der Discrepanz gefundener rechts- und linksseitigen Knochen berechnet (G. Backman); Einige bemerkenswerte Pilzformen aus den Kohlengruben Schonens (O. Gertz); Über den chemischen Aufbau der Zellwände bei *Ulva* und *Enteromorpha* (H. Kylin); Über die Natur der Peroxydasereaktion der Algen (S. Rönnerstrand); Kleinere Notizen über freilebenden Nematoden (C. A. Allgén); Colombianische Blattodeen, gesammelt von Herrn G. Dahl und Frau Althén-Dahl in den Jahren 1936-1939 (K. Princis); Drei neue neotropische Blattodeen (K. Princis); Die Verbreitung der Amphibien und Reptilien in Estland (H. Kauri); Observations on the development of *Erysiphe graminis* DC. (K. Björling); Preliminary report on certain Swedish freshwater Oligochaeta (T. Almstedt); A note on the type of *Rana arvalis* Sv. Nilss. (T. Gislén); Studier över könskvoten hos vattenödlor (O. Persson; Eng. summary); Über den Zuwachs der Keimlinge von *Ulva lactuca* in verschiedenen Nährflüssigkeiten (H. Kylin).



SCIENCE EXPERIENCES WITH HOME EQUIPMENT.

By Carleton John Lynde. *International Textbook Company, Scranton.* \$1.60. xiv + 226 pp.; ill. 1937.

This is not a new book, nor are the experiments it

contains biological, except for one section on body balance and reflexes; but the very simple experiments on physical properties that are outlined indicate a direction in which laboratory planning for children should go. Anyone who has the task of preparing a laboratory manual will find fruitful suggestions here.

ORIGIN AND DEVELOPMENT OF CRATERS. *The Geological Society of America Memoir 21.*

By T. A. Jaggar. *The Geological Society of America, New York.* \$6.00. xviii + 508 pp. + 87 plates; text ill. 1947.

In this volume the author records the results of 25 years of study of Hawaiian volcanos. Most of this material is highly technical and will thus be of interest only to those specializing in volcanology and related subjects. Of perhaps more general interest are the numerous excellent photographs which illustrate various phases of volcanic activity.

THOMAS W. AMSDEN

CONVECTION PATTERNS IN THE ATMOSPHERE AND OCEAN. *Annals of the New York Academy of Sciences, Volume XLVIII, Article 8.*

By R. B. Montgomery, John C. Armstrong, Horace R. Byers, Phil E. Church, Richard A. Craig, B. Haurwitz, Walter H. Munk, Henry Stommel, Harry Wexler, Raymond Wexler, A. H. Woodcock, and Jeffries Wyman. *New York Academy of Sciences, New York.* \$2.00 (paper). Pp. 705-844 + 15 plates. 1947.

POLYELECTRONS. *Annals of The New York Academy of Sciences. Volume XLVIII, Article 3.*

By John Archibald Wheeler. *The New York Academy of Sciences, New York.* 75 cents (paper). Pp. 219-238. 1946.

THE LIMITATIONS OF OPTICAL IMAGE FORMATION. *Annals of the New York Academy of Sciences, Volume XLVIII, Article 1.*

By Max Herzberger. *New York Academy of Sciences, New York.* 75 cents (paper). Pp. 1-30. 1946.

THE QUARTERLY REVIEW of BIOLOGY



THE GEOGRAPHICAL DISTRIBUTION OF COLD-BLOODED VERTEBRATES

(CONCLUDED)

By P. J. DARLINGTON JR.

Museum of Comparative Zoology, Cambridge, Mass.

DISPERSAL AND CLIMATE

DESCRPTION of the actual distributions of existing cold-blooded vertebrate groups has been completed in the preceding section. This and the following sections will be concerned with analysis and discussion.

Matthew, in *Climate and Evolution* (1915, pp. 172-173; 1939, p. 3), states a thesis which can be reduced to two main propositions: (1) that the north temperate zone, because of its variable climate, has been the principal center of evolution and dispersal of land vertebrates, and (2) that no great changes in world geography, and no extraordinary land bridges, are necessary to account for vertebrate distribution.

I think that the first of these propositions is wrong, so far as cold-blooded vertebrates are concerned. Fresh-water fishes, amphibians, and reptiles seem all to have dispersed from the tropics into the north temperate zone, more than the reverse. Some of them that have been in the north have withdrawn from there, but that does not mean that they originated there. Failure to distinguish evidence of withdrawal from evidence of origin and spreading is a basic error. The north temperate zone, especially its colder part, is apparently not a great center of evolution of

cold-blooded vertebrate life, but a marginal area where such life is limited.

North temperate climate is characterized primarily by a lower mean temperature than that of the tropics and by an alternation of warm and cold seasons. The effect of these factors on cold-blooded vertebrates is probably complex. Different groups reach their northern limits at no definite isotherms and in no fixed order (Figure 3). Obviously, the limiting effect of climate will have to be looked for, not in the simple effect of single factors on single species, but in general correlations.

There is a definite correlation between northern limits, the development of independent north temperate faunas, and the distribution of phylogenetic relicts in the different classes of cold-blooded vertebrates. Fresh-water fishes go farthest north, and are numerous in cold north temperate climates; they have developed an independent north temperate fauna characterized by peculiar families and even orders; and relicts of ancient groups occur in the north temperate zone as well as in the tropics and Australia. Amphibians reach the Arctic more or less around the world, and are fairly numerous in the colder parts of the north temperate zone; they have developed an independent north temperate fauna characterized by salamanders and a few more or less dis-

tinct groups of frogs; and archaic relicts are scattered in the north temperate zone as well as in the the tropics and New Zealand. Reptiles fall far short of the Arctic in most parts of the world, and are relatively few in the colder parts of the north temperate zone [e. g., Schreiber (1912) lists only 5 genera, 6 species of reptiles to 6 genera, 11 species of amphibians in northern Europe, but 37 genera, 89 species of reptiles to 14 genera, 39 species of amphibians in southern Europe]; reptiles have developed no well defined north temperate fauna; and they lack isolated archaic relicts pe-

(cf. Moore, 1942, p. 194); their heat requirements are apparently not great. Reptiles have, if not a more complex, at least a more highly organized mode of reproduction, more affected by cold. Many northern lizards and snakes, including the northernmost of all, manage to reproduce by becoming ovoviviparous: the female retains the eggs and "follows the sun" until they hatch. This is an adaptation for obtaining heat rather than for withstanding cold, and it emphasizes the fact that reptiles cannot reproduce in such cold places as amphibians.

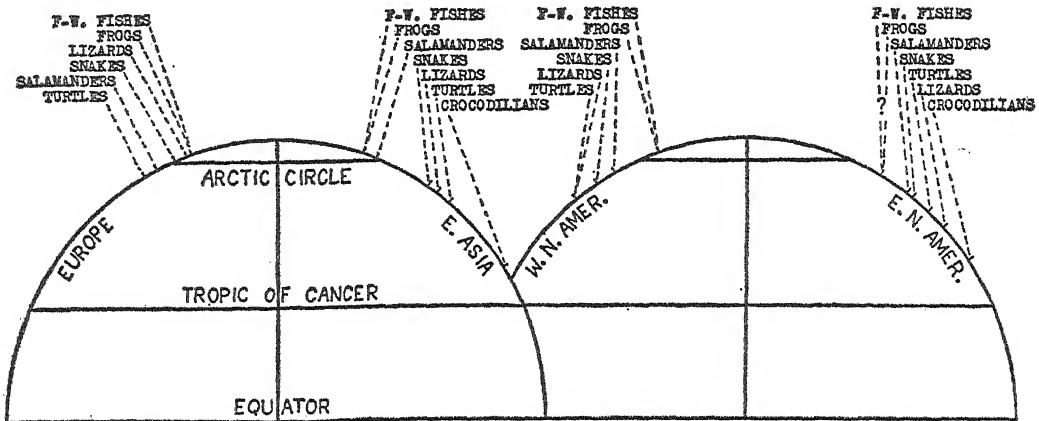


FIG. 3. DIAGRAM OF NORTHERN LIMITS OF ORDERS OF COLD-BLOODED VERTEBRATES

The two hemispheres are diagrammatic profiles of the earth from the equator to the North Pole in the regions named. Points are marked to show the approximate northern limits of orders of cold-blooded vertebrates on the curve of the earth in each region. Data on which the diagram is based are given in the text. The diagram is provisional. It is fairly accurate for Europe, next best for western North America, least accurate for eastern Asia and eastern North America.

culiar to the north temperate zone. Apparently, then, fresh-water fishes are most successful in the north, and evolve and persist there for long periods. Amphibians are fairly successful there, and evolve and persist in some cases. But reptiles are not successful there, and although they invade cold northern regions, they do not evolve there much nor persist there long.

The success of cold-blooded vertebrates in the north varies with their place on the evolutionary scale: fishes, the lowest forms, are most successful; reptiles, the highest, least so. This has something to do with reproduction and something to do with habitat. Fishes have the most primitive, simplest mode of reproduction and the one which, I suppose, is least affected by cold. Amphibians have a more complicated development, but some of them can shorten the larval period sufficiently to complete it during the short arctic summer

As to habitat, water is a great buffer against cold. Fully aquatic animals such as fishes have an advantage in cold climates which is only partly shared by amphibians and is not shared by most reptiles. For some reason, this advantage seems not to hold within the classes. The most aquatic salamanders and frogs are not the most northern. Amphibious crocodiles and turtles do not range so far north as terrestrial lizards and snakes. But here is a curious fact. Of only 9 existing genera of crocodilians, one (*Alligator*) occurs in parts of both temperate Eurasia and temperate North America but nowhere in the tropics. Of 57 genera of non-marine turtles, one (*Emys*) is similarly Holarctic and another (*Clemmys*) is nearly so. But of about 600 genera of lizards and snakes, probably none has such a distribution; all well defined genera that are common to both halves of the north temperate zone occur also somewhere in

the tropics. One possible explanation of this fact is that amphibious crocodiles and turtles were formerly more successful than terrestrial reptiles in cool climates and that, although they are now archaic groups withdrawing into the tropics, fragments of their old north temperate fauna still persist. It may be significant that Colbert, Cowles, and Bogert (1946) find that individual American alligators have "surprising" tolerance for cold.

A general dominance is characteristic of northernmost amphibians and reptiles. The absolute northern limit of amphibians is set by the frog genus *Rana*, which is dominant in the tropics, but which ranges north of any primarily cold-adapted genus of frogs and north of all salamanders. Another great tropical genus of frogs, *Bufo*, ranges far northward too. The northernmost lizard genus, *Lacerta*, is dominant in north temperate Eurasia and occurs also in tropical Africa. Of snakes, the most northern genus, *Vipera*, is widely distributed in the Old World tropics; and the most northern oviparous snake belongs to the genus *Natrix*, which is dominant over much of the world, including the Old World tropics.

Several factors probably combine to determine the northern limit of any animal. For example, *Rana* would not reach the Arctic if it could not breed there, and it might not be able to breed there if its mode of reproduction were not the primitive one of the Amphibia. It might not be able to survive there if it were not itself amphibious, so that it could at times take advantage of water as a buffer against cold. And it probably would not have invaded the Arctic at all if it were not dominant elsewhere in the world.

To summarize the relation of dispersal to climate, I should say that dispersal of cold-blooded vertebrates has apparently been primarily from the tropics into temperate areas, but that the limits reached by different groups, and their success in cold places, have depended on many factors.

DISPERSAL BETWEEN OLD AND NEW WORLDS

Ancient tropical fresh-water fishes apparently moved from the Old World to South America; ameiriid catfishes, suckers, and cyprinids, from the Old World to North America; *Bufo*, *Rana*, brevicipitid frogs, and emydid turtles, from the Old World to North and South America. These are, as it were, straws all moving in one direction, from the Old World to the New. Straws often

show which way a wind blows—does some wind blow these particular straws? I think one does. It is revealed when we turn from study of single families to analysis of whole faunas, especially the fauna of South America.

South America was an island during most of the Tertiary. Only near the beginning and again near the end of that period was the continent connected with the rest of the world so as to allow much exchange of land animals. This is proved by the history of mammals (Simpson, 1940a), and by other evidence. Existing families of amphibians and reptiles in South America fall into two fairly well defined groups (Table 8; cf. Schmidt, 1943, p. 252). One group, marked by much generic endemism, probably dates from the earlier connection; the other, marked by little or no generic endemism, probably dates from the later one.

The early South American fauna of amphibians and reptiles includes 19 families, all of which occur also in the Old World, except that the Teiidae is represented there by the closely related Lacertidae; but there are additional families, old or diverse in the Old World, which are not represented in the early South American fauna: of frogs, the Ascaphidae, Discoglossidae, Pelobatidae (all old), and the Bufonidae, Ranidae, and Rhacophoridae (diverse); of turtles, the Trionychidae (old and diverse); of lizards, the Chamaeleontidae and Varanidae (old) and the Scincidae and Agamidae (perhaps old, certainly diverse). Other smaller or more localized families peculiar to the Old World could be added to this list.

The late South American fauna of amphibians and reptiles includes 10 families not present in the early fauna. Of these, nine exist or are fossil in the old World; but there are additional families existing in the Old World which are not represented in the late South American fauna.

South American fresh-water fishes, it will be remembered (Table 5), include many endemic families, but the orders, and the main stocks within the orders, all occur in the Old World; and there are additional, significant stocks of fresh-water fishes in the Old World that are not in South America. It will be seen that the amphibians and reptiles fall into this same pattern, but at the level of families rather than that of higher groups. No family of amphibians or reptiles is peculiar to South America; most of the families in South America, including all the early ones, are represented in the Old World; and there are additional,

TABLE 8

South American families of amphibians and reptiles

Key: "x" indicates presence; "0", absence; "S", families that reach only the southern edge of temperate North America.

	ARRIVED		PRESENT IN OLD WORLD	IN TEMPERATE N. AMERICA
	Early	Late		
CAECILIANS				
Caeciliidae.....	x		Africa, Orient	0
SALAMANDERS				
Plethodontidae (<i>Oedipus</i> only).....		x	Europe	x
FROGS				
Pipidae.....	x		Africa	0
Bufo (Bufo) only.....		x	Wide	x
Leptodactylidae.....	x		Australian Reg., South Africa, (fossil in India)	S
Atelopodidae.....	x		Orient	0
Hylidae.....	x		Temp. Eurasia, Australian Reg.	x
Ranidae (<i>Rana</i> only).....		x	Wide	x
Brevicipitidae.....	x		Wide	x
CROCODILIANS				
Crocodylidae.....	x		Wide	x
TURTLES				
Chelydridae (<i>Chelydra</i> only).....		x	(Fossil in Eurasia)	x
Kinosternidae (<i>Kinosternon</i> only).....		x	0	x
Emydidae (<i>Geoemyda</i> & <i>Trachemys</i>).....		x	Eurasia	x
Testudinidae (<i>Testudo</i> only).....		x	Wide	x
Pelomedusidae.....	x		Africa, (fossil elsewhere)	(Fossil)
Chelyidae.....	x		Australian Reg., (prob. fossil in Orient)	0
LIZARDS				
Gekkonidae.....	x		Wide	x
Iguanidae.....	x		Madagascar, Fiji	x
Anguidae (2 genera).....		x	N. temp. & Orient	x
Teiidae.....	x		(Lacertidae)	x
Amphisbaenidae.....	x		Africa etc.	x
Scincidae (<i>Mabuya</i> only).....		x	Wide	x
SNAKES				
Boidae.....	x		Wide	x
Typhlopidae.....	x		Wide	S
Leptotyphlopidae.....	x		Africa etc.	x
Anilidae.....	x		Orient	0
Colubridae (s. lat.).....	x		Wide	x
Elapidae.....	x		Wide	x
Viperidae (3 genera).....		x	Wide	x

significant families in the Old World that are not in South America.

The origin of the South American fauna will be discussed in more detail below. For the moment I wish to draw just one conclusion. Before or at

the beginning of the Tertiary, immigrants representing some, but not all, contemporaneous Old World stocks of cold-blooded vertebrates somehow reached South America and persisted and radiated there. And toward the end of the Tertiary addi-

tional immigrants, again representing some but not all contemporaneous Old World stocks of amphibians and reptiles (and one or two stocks apparently endemic in North or Central America), reached South America across the existing land bridge. There seems only one reasonable explanation of all this. As between the Old World and South America, the Old World has been the principal center of evolution of great stocks of cold-blooded vertebrates, and the direction of their dispersal has been from the Old World to South America.

AREA, CLIMATE, AND EVOLUTION

If cold-blooded vertebrates have moved mostly from the tropics into temperate areas, and from the Old World to South America, then the main center of their evolution and dispersal has been the tropics of the Old World. Reasons can be found why this might be so.

Three kinds of evolution can be distinguished in theory, although they are probably mixed in fact and may be supplemented by additional minor processes. All three have the same principal mechanism: occurrence of mutations, and survival and spread of some mutations through populations. The first kind of evolution, *differentiation of species*, is a process in which survival and spread of mutations may be partly random; it probably proceeds most rapidly in small, isolated populations. The second kind of evolution, *adaptation to special environments*, is not random; mutations that happen to be advantageous under special conditions are selected. Rate of adaptation must vary with force of selection. When selection is so strong that advantageous mutations usually survive and spread, the rate of adaptation will vary with size of populations, for, other things being equal, size of populations determines the number of mutations that will probably occur. Of two otherwise identical populations, one with twice as many individuals as the other, the larger is twice as likely to originate any single mutation, and in processes that depend on an occurrence of series of different mutations the statistical advantage of the larger population is great. Size of populations depends partly on the area and continuity of the environments they inhabit. It follows that adaptation should be most rapid in environments that are extensive and more or less continuous. The third kind of evolution is *general adaptation*. It includes all the improve-

ments of organs and functions that allow some animals to live more efficiently than others in many environments, to react more rapidly or more intelligently, or to produce more offspring, or offspring that are more likely to survive. It is adaptation to the general environment of the world, and it should lead to general dominance, to success over great areas and in many special environments. Like special adaptation, it should be most rapid in the largest populations, which might be expected to exist where the general conditions of life are most favorable over the largest areas. For most cold-blooded vertebrates this is probably in the tropics of the Old World.

Both area and climate are involved in this conception. The large habitable area of the Old World tropics gives room for large populations. The favorable, stable climate of the tropics may sometimes favor dense populations, and probably allows a maximum number of generations of cold-blooded animals and so accelerates all kinds of evolution among them. Also, if general adaptation proceeds by continual radiation of few rather than by modification of many stocks, it should be most rapid where species are numerous as well as where populations are large. And the mere mass and diversity of life in large tropical areas may increase selective pressures and accelerate adaptation. The idea of evolution of dominant animals in great, densely populated areas is not new. It goes back to Darwin, although it has not been given sufficient attention by recent zoogeographers. I have merely restated the idea in terms of modern genetics.

Of course, the matter is not really so simple as this. Adaptation may be most rapid in populations that are not only large but that fluctuate violently or form many small, *partly* isolated subpopulations, which only occasionally interbreed. A more serious complication is that we do not know where the largest populations really are. It is often stated by naturalists that the old and stable tropics are inhabited by enormous numbers of species, which have small populations. My own experience of about five years in the tropics suggests that this is true, but that it is not the whole truth. If many rare species exist in the tropics, so do some common ones. But large populations occur also outside the tropics, perhaps especially in new or marginal areas. Some species of frogs and snakes are very common in great areas of northern North America, for example. Possibly the most rapid progressive evolution

occurs in short periods when great, new, *favorable* areas first become available to life, or when a stock first becomes able to spread into great areas that are new and favorable for it (cf. mammals, below). There is no use guessing further about this here. Whatever the details of the explanation, there is much evidence that the main center of evolution of dominant groups of fresh-water fishes, amphibians, and reptiles has in fact been the tropical part of the Old World, which is the largest favorable area for the existence of cold-blooded life. [Concerning population size and evolution, see Fisher (1930, p. 118), Dobzhansky (1914, Chapter 10), Simpson (1944, pp. 65-74), and Wright (papers cited by Simpson); concerning climate and evolution, see Muller (1942, p. 121); concerning rates of evolution, see Simpson (1944). I do not agree with Simpson that "mega-evolution," the origin of major families and orders, usually occurs in small populations. The origin of major groups of animals probably involves general adaptation, which might occur in a geologically short period of time, but probably requires large populations in large, favorable areas.]

The relation between special adaptation and general adaptation, leading to dominance, can be illustrated. Various snakes in many parts of the world are semi-aquatic, but three groups of them are more highly adapted than others to life in water, as they have valvular nostrils (Smith, 1943, pp. 17-19) and sometimes flattened tails. These groups are the Acrochordinae and Homalopsinae, fresh- and salt-water snakes derived from the Colubridae; and the Hydrophiidae, sea snakes, derived from the Elapidae. The three have originated independently, but all are confined to or center in the tropical Orient and islands to the south and east. Cyprinid fishes and probably emydid turtles did not acquire their aquatic adaptations in the Orient, but they have diversified there and apparently evolved there a dominance which has enabled them to spread widely. The tropical Orient is probably the only place where any land reptiles became fully aquatic during the Tertiary; and the Cyprinidae are the only fresh-water fishes and the Emydidae the only fresh-water turtles that became dominant and spread so extensively during the Tertiary. Perhaps marine catfishes should be added to the list of animals that have risen in the tropical Orient. One family of them, the Plotosidae, is confined to the

Indo-Pacific region. The other, the Ariidae, occurs in warm seas around the world but is perhaps most recent in the Atlantic. It has entered fresh water in the Indo-Pacific region, but not in the West Indies. These catfishes are the only Ostariophysi and perhaps the only fishes that have successfully moved from fresh water into the sea recently. The convergence of the clues provided by all these groups of animals suggests that fresh-water and estuarine habitats were very extensive in the tropical Orient during the Tertiary and were inhabited by great populations of many animals, of which some became specially adapted to life in the water while others, already aquatic or amphibious, attained a general dominance that enabled them to spread over other parts of the world or to enter the sea.

The actual existence of dominance among animals is shown by observation of existing forms and in other ways. The fossil record shows many correlations of the rise of some groups with the disappearance of others, and the dominance of the ascendant groups has often been so great that no relicts of the others have survived. A bit of special evidence is that dominant genera of amphibians and reptiles range farther into the Arctic than specifically cold-adapted genera, as if the factors that make for dominance were stronger than long adaptation to cold. Finally, there is apparent direction in the dispersal of both plants and animals introduced into different parts of the world by man. Eurasian species tend to be successful in North America more than the reverse, and species from the larger continents tend to be successful in Australia and on islands. There are many individual exceptions, but the general direction of successful introduction seems to have been from larger to smaller land masses. The species of the larger land masses are usually dominant, as they should be, if what I have said about general adaptation is correct. Many of the introduced species are successful only in disturbed habitats, but other plants and animals, over longer periods of time, have spread naturally over the world, and it seems likely that they have shown the same order of dominance as the introduced forms, and have dispersed from large to small areas.

It is not clear whether introduced plants and animals have tended to move also from warm to cool climates. Movement in that direction is to be expected less among those plants and insects that are at home in cool places than among cold-

blooded vertebrates. Centers of evolution and dispersal of different groups probably vary with toleration for cold and with other factors. One might expect dominant stocks in each case to evolve in and to disperse from their most favorable and largest habitable areas.

A special case worth a moment's consideration is what would happen, theoretically, if a group of cold-blooded vertebrates became warm-blooded, as mammals and birds have done. They would become relatively independent of temperature, could cross climatic boundaries easily, and should be relatively successful in cold places. The area of evolution of dominant groups should then be extended northward, and might come to include not only the Old World tropics but the whole of the accessible north temperate zone. Warm-bloodedness might permit evolution of special processes. For example, more heat is apparently required for reproduction by reptiles than by amphibians, and still more heat plus control of temperature may be necessary for mammalian placental reproduction. But the most important effect of warm-bloodedness may be that, by opening areas of cool climate and by reducing the importance of local climatic barriers, it makes possible the existence of more, larger, and therefore more adaptable populations, and facilitates general adaptation. If so, warm-bloodedness may have allowed mammals not only to evolve a superior sort of reproduction but rapidly to become in every way better animals. This may have had something to do with the way they so abruptly replaced dinosaurs at the end of the Cretaceous.

Another and a very different thing, which tends to minimize barriers, increase the effective size of populations, and probably to facilitate general adaptation, is ability to fly. This fact may in part account for the dominance of insects and birds.

THE MAIN PATTERN OF DISPERSAL

The main pattern of dispersal of cold-blooded vertebrates is apparently evolution of dominant groups in the tropics of the Old World, and spreading of the dominant forms into less favorable climates and smaller areas. The spreading can occur along three chief routes (Figure 4).

A short route leads into temperate South Africa. Movement in this direction is from a more to a less favorable climate and from a larger to a smaller area. There are no great obstacles to dispersal in

this direction except climate. Fresh-water fishes, frogs, and reptiles have all reached South Africa in some numbers, although there are many families of them in the African tropics that do not reach the south temperate zone. Most of the South African forms are not very different from those of tropical Africa. The most distinct South African group is an isolated genus of leptodactylid frogs. Frogs of the subfamily Brevicipitinae are confined to East and South Africa and may be retreating southwards, for the East African forms have discontinuous, relict ranges. Some groups, such as land turtles of the family Testudinidae and lizards of the African family Cordylidae (Zonuridae), are more diverse in south temperate than in tropical Africa, but they may be adapted to steppes and deserts more than to the south temperate climate.

A second route leads from the Orient to Australia and New Zealand. This is also from larger to smaller areas and, in the southern hemisphere, from more to less favorable climates. The principal obstacle along this route is salt water, and cold-blooded vertebrates have dispersed apparently according to their powers of crossing it. Most fresh-water fishes stop at Java and Borneo, at the edge of the continental shelf of Asia. Ceratodontid lungfishes may be the only strictly fresh-water fishes that reached Australia even in ancient times, and even they may not have required continuous fresh water. So many existing fresh-water fishes are tolerant of salt water that we should not be dogmatic about ancient ones. Frogs have reached Australia several times and New Zealand once, but they have apparently done so with difficulty and at long intervals. The family that occurs in New Zealand no longer exists in Australia or the Orient. Leptodactylids and *Hyla*, which occur in Tasmania and temperate Australia as well as in tropical Australia and New Guinea, no longer exist in the Oriental Region, except that *Hyla* enters its northern edge. The brevicipitid frogs of New Guinea and tropical Australia form endemic subfamilies. Only the Ranidae are distributed and related as if they had reached the Australian Region recently. Of reptiles, *Sphenodon* is a unique relict. Its habits suggest that it may have reached New Zealand across an ocean barrier, and it has survived there, isolated from competition with most modern reptiles. It is an exception to the rule that reptiles in cool places develop rapidly, for its eggs take about a year to hatch. Perhaps failure to accelerate reproductive and developmental processes

contributed to the lack of dominance of the Rhynchocephalia. Non-marine turtles seem to have had trouble in reaching Australia, and they are not known to have reached New Zealand. The two families, Chelyidae and Carettochelyidae, that exist in the Australian Region have disappeared from the Orient, although both are apparently fossil there. Terrestrial *Testudo* has reached the

The third route of dispersal from the Old World tropics follows an arc through temperate Eurasia and North America to tropical Central and South America. From the Old World tropics into temperate Eurasia is from a more to a less favorable climate and, for most cold-blooded vertebrates, from a larger to a smaller habitable area; both factors should favor dispersal northward. From tem-

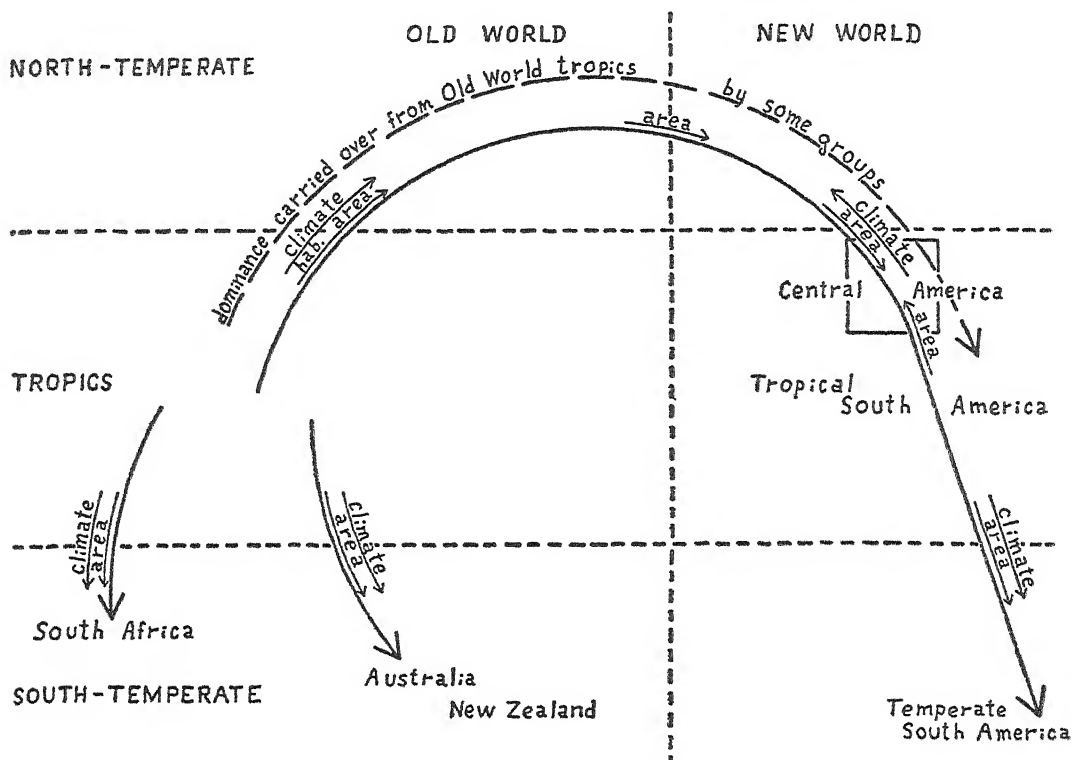


FIG. 4. PRINCIPAL EXISTING ROUTES OF DISPERSAL OF COLD-BLOODED VERTEBRATES

The diagram is intended to suggest origin of dominant groups of cold-blooded vertebrates in the Old World tropics and dispersal along three principal routes toward less favorable climates and smaller areas. Small arrows show the direction of effect of climate and area at critical points on the dispersal routes. See text for more detailed explanation.

Moluccas but not the Australian Region proper. Lizards seem to have reached Australia from the Orient easily and often: some genera are still common to the two regions. Two lizard families have reached New Zealand: the Gekkonidae are represented there by two endemic genera; the Scincidae, by about 9 endemic species of *Lygosoma*, a widely distributed genus which is abundant in the Orient and Australia but is absent in South America. Several aquatic and terrestrial snakes have reached Australia from the Orient more or less recently; again there are genera in common; but no snake has reached New Zealand.

perate Eurasia to North America is from a larger to a smaller area; there is no great change of climate, but temperate Eurasian groups may carry a dominance evolved in the Old World tropics; the sum of factors should favor movement toward America. From North to Central America is again from a larger to a smaller area, but from a less to a more favorable climate; area should favor but climate oppose dispersal. From Central to South America involves no great change of climate but is from a smaller to a larger area, which should oppose dispersal. But dominance acquired in the Old World tropics may be carried through the

north temperate zone and Central America to South America. Obviously, theoretical forces favoring dispersal decrease along this arc. Reverse movements might reasonably be supposed to occur locally, and probably have occurred: a sucker seems to have moved from North America back to the near corner of Asia; several groups of frogs and lizards are distributed as if they had moved from tropical America for varying distances into North America; and frogs of the genus *Hyla* may possibly have moved back from the American tropics through North America to temperate Eurasia. But, if the general theory is correct, it should be very rare for a group of cold-blooded vertebrates to follow the whole arc backwards and successfully repopulate the Old World tropics.

Different kinds of cold-blooded vertebrates should behave differently as they follow the arc from the Old World tropics through the north temperate zone to the American tropics. Strictly fresh-water fishes move slowly, from one drainage system to another, and are checked by relatively narrow barriers of salt water; they are tolerant of cold, occupy large areas in the north, and develop great northern faunas which may block dispersal of all except the most dominant of later tropical groups. Amphibians can disperse more rapidly, and apparently get across narrow salt-water barriers somewhat more readily; they are fairly tolerant of cold, and develop fairly distinct northern faunas. Reptiles can disperse still more rapidly, and get across narrow ocean gaps comparatively easily; they are less tolerant of cold, occupy smaller areas in the north, and do not develop persistent northern faunas likely to block dispersal of later tropical groups. These differences should be reflected in the faunas that accumulate at the end of the arc.

Central America has a cold-blooded vertebrate fauna which is significantly different from that of South America. South America has 21 families of primary-division fresh-water fishes. Eight of the families (4 of catfishes and 4 of characins) have gotten a slight hold in Panama or Panama and Costa Rica; but only 3 (additional) families range farther into Central America: gymnotid eels, to Guatemala; pimelodid catfishes and the Characidae, through Central America to southern Mexico and the Rio Grande respectively (Myers, 1938, p. 350). Of North American primary-division fishes, Central America has received only suckers and ameuriid catfishes, and these two families reach

only Guatemala; and Central America entirely lacks peculiar primary-division families. Central America is, therefore, notably poor in strictly fresh-water fishes. But it has disproportionately many secondary-division, salt-tolerant fish of the Cyprinodontes and Cichlidae. Of amphibians, South America has 6 genera of caecilians, but only one occurs in Central America north of Panama (Dunn, 1942). South America has only one genus of salamanders, which is also the only genus in Central America. South America has 7 families of frogs and toads, of which all except the Pipidae are represented also in Central America; but of genera, Noble (1922, pp. 67-70) counts 60 in South America of which only 21 reach Central America, where only 4 genera are endemic. These exact figures would be challenged by more recent herpetologists, but the comparative lack of diversity of Central American frogs can hardly be questioned. But in reptiles the situation is very different. Schmidt (1943, p. 250) finds only 22 families of reptiles in South America, against 24 in Central America. The small area of Central America is therefore inhabited by more reptile families than the whole of the vastly larger and more varied South American continent; and many genera of reptiles are either confined to Central America or occur there but not in South America. So, as compared with South America, Central America has strikingly few fresh-water fishes except salt-tolerant ones; only a moderate number of amphibians; but many, diverse reptiles.

Central America may have been an island or a series of islands, isolated from North as well as from South America by ocean gaps, during part of the Tertiary. This may account for the predominance of fishes of salt-tolerant families, and in part for the diversity of reptiles, for many of the latter are notorious crossers of narrow salt-water barriers; but it hardly accounts for the presence in Central America of what appear to be both relict and immigrant groups of fresh-water turtles which, to judge from what we find in both the East and the West Indies, cross salt water less readily than frogs. But the theory that the Central American fauna owes its nature entirely to immigration across ocean gaps leaves unexplained something even more important. Of the few amphibians that have reached Central America recently from the north, all have pushed on into South America; of the many reptiles, few have entered South America. It looks as if amphibians, which disperse more

slowly and may be more delayed by barriers, and which have evolved cold-adapted, road-blocking northern faunas, have reached the American tropics only rarely, but always as dominant groups; while reptiles, which disperse more rapidly and are less delayed by barriers, at least of salt water, and which do not evolve road-blocking northern faunas, have filtered through the northern hemisphere comparatively often, but with varying dominance. Many have been able to enter and survive in the small area of Central America; fewer, to push into the larger area of tropical South America. This finding agrees strikingly with the expectation expressed above, and with Figure 4.

Phylogenetic (archaic) relicts occur in two sorts of places in the main dispersal pattern of cold-blooded vertebrates. Rarely, they are geographically isolated, outside the usual limits of distribution of their classes. There is one such case among fresh-water fishes (the lungfish in Australia), one among amphibians (the frog, actually 2 or 3 related species, on New Zealand), and one among reptiles (*Sphenodon* on New Zealand). What is not usually realized is that these cases are unique among cold-blooded vertebrates. There are some other cases of striking geographic isolation of species far from the present main areas of distribution of their families, but the isolated forms are not peculiarly archaic; they are geographic, not phylogenetic relicts. Most of the truly archaic forms actually occur in the largest, most stable, and (for each class) most habitable areas: the fresh-water fishes and the amphibians, in the tropics and the north temperate zone; the reptiles, centering on the tropics. The one sort of place in which archaic relicts rarely or never occur is in marginal, unstable or unfavorable, incompletely isolated areas. For example, no archaic type of reptile is peculiar to the north temperate zone, which is marginal for reptiles; and no archaic amphibian nor reptile is relict in Australia, which is probably marginal for them, less isolated than it is for fresh-water fishes or for mammals. Except for this general rule, there seems to be no definite relationship between the place of origin of a major group and the place where its last relict survives. The most striking relicts, the last survivors of great families and orders, are apparently in each case laws unto themselves as regards not only place but means of survival. Some survive by means of close adaptation to special environments; others, by competing more or less openly and successfully with great

modern faunas; and a few, by reaching and persisting in very isolated places.

The distribution of primitive forms during the evolution and spread of dominant groups of animals is a problem which is related to, but not the same as, the distribution of archaic relicts. It is believed by some that the primitive forms stay at the dispersal center; by others, that they are forced to the periphery; but both beliefs probably oversimplify the problem. There are two kinds of peripheral areas: those that are peripheral because conditions there are less favorable than at the dispersal center, and those that are peripheral because they are distant from the dispersal center. And it is necessary to distinguish two kinds of spreading: the initial spread of a group of animals, and later waves of spreading of successive dominant elements within the group. In each case, it is the dominant elements which spread; they not only evolve and maintain themselves at the dispersal center but force their way into new territory at the expense of competing animals; but the patterns produced should be different. During the initial spread, dominant elements, numerous at the dispersal center, should be the *only* ones in all peripheral areas; non-dominant elements should occur only at the dispersal center. During the spread of later dominant elements (for example during the spread of the Cyprinidae, the latest dominant cypriniform fishes, from the Oriental tropics), the dominant elements are again numerous at the center; they may be relatively even more numerous in unfavorable-peripheral areas, where they may overwhelm almost all other competing forms (as the Cyprinidae seem to have done in temperate Eurasia); but they should be relatively few or absent in distant-peripheral areas. In such a case, the earlier, now non-dominant elements should be most numerous in distant-peripheral areas, perhaps still present in reduced numbers at the dispersal center, and least numerous or absent in unfavorable-peripheral areas. (This agrees well enough with the findings stated above about the final distribution of relicts.) It should be noted that the statement concerns *non-dominant* elements. It would hold for *primitive* elements only to the extent that they are the same as the nondominant ones; probably they often are the same, but perhaps sometimes they are not. It may be possible, as some taxonomists claim, to find the center of origin of a group of animals by

recognizing, and tracing the distribution of, the "primitive" forms, but the matter is not simple.

ANCIENT LAND BRIDGES AND ANCIENT CLIMATES

A land bridge exists between North and South America; intermittent bridges have surely joined Eurasia and North America; and an ancient bridge may have connected Asia and Australia. I want here to discuss some other, more hypothetical ancient bridges which are supported, or not supported, by evidence of the cold-blooded vertebrates.

South America was certainly connected with the rest of the world at or before the beginning of the Tertiary, but it is a question whether the connection was with North America. If so, the old fauna which came over it should in a general way resemble the new fauna which has come via North America.

The old South American fauna of amphibians and reptiles is derivable entirely from about 19 Old World families, as has been emphasized earlier. The new fauna includes 10 additional families, of which 9 exist or are fossil in the Old World; but the tenth (Kinosternidae) is confined to the Americas, and one or two others are much more North American than Old World in present distribution. The old fauna, then, apparently lacks a distinct North American element, while the new fauna has one. But the old fauna consists of groups that reached South America and survived there; the new one, of groups that have reached South America but have perhaps not settled the matter of survival. Many mammals entered South America in the Pliocene, but only a part of them survived; perhaps only part of the amphibians and reptiles will do so. But which part?

Of the new amphibians and reptiles, *Oedipus* and *Kinosternon* most obviously represent North or Central American groups. *Oedipus* is a genus of salamanders of the family Plethodontidae. The family may not actually have originated in North America, but it occurs chiefly there. *Oedipus* itself does not occur north of southern Mexico and is numerous in species in Central America, where it may have originated; from there it has spread south along the Andes through half the length of South America, but it has invaded South American lowlands very little. Two other amphibian genera seem to have reached South America recently: *Bufo* and *Rana*. I would predict that, if they compete, as salamanders and frogs may do, *Bufo* and *Rana*, which are dominant over much of the rest

of the world, will survive in South America, and *Oedipus* will not. *Kinosternon* is a genus of freshwater turtles of the family Kinosternidae, a family of only three genera, of which two are confined to part of Central America. *Kinosternon* itself occurs from Central America north through much of eastern North America and south through the northern half of South America. Two other genera of freshwater turtles have invaded South America more or less recently and extensively. Both belong to the family Emydidae. I would predict that, if they compete, emydids, which are dominant in the Orient and North America, will survive in South America, and *Kinosternon* will not.

Perhaps in these cases distance and rate of dispersal should be stressed more than place of origin. The Plethodontidae, with one species relict in Europe, and the Kinosternidae, of unknown history, may have originated in the Old World, but if so they have dispersed so slowly that they have had time to recede there and to evolve peculiar stocks in North and Central America. These stocks were at the threshold when the door to South America was reopened, and they perhaps entered at once. *Bufo*, *Rana*, and the Emydidae have apparently dispersed from the Old World more rapidly and are still dominant there, and they have had less time to evolve in North and Central America. They have moved farther, or faster, than *Oedipus* or *Kinosternon*, and they may have arrived later, but they will probably be dominant in South America as elsewhere.

It is not necessary to discuss other cases. The new amphibian and reptile fauna which is accumulating in South America is of mixed origin, but the elements in it that are most likely to survive are dominant Old World stocks. The new fauna is reaching South America via North America, but it may eventually consist entirely of derivatives of a fraction of existing Old World families. So it seems that the old South American fauna of amphibians and reptiles may have arrived via North America too, although it now consists entirely of derivatives of a fraction of ancient Old World families. The question is, if the ancient immigrants reached South America from the Old World via North America, how much need North America have marked them? Perhaps not much, and the deepest marks may have been the soonest erased. That is, the most characteristic North American stocks may have been the least persistent in South America.

South American fresh-water fishes, too, are derivatives of a fraction of ancient Old World stocks. They have differentiated more than the amphibians and reptiles; either they have been in South America longer or they have evolved faster. I have tried, in preceding pages, to show how their ancestors might have filtered through the northern hemisphere from the tropics of the Old World. No strictly fresh-water fishes have reached South America recently, so there is no new fauna with which to compare the old one, but several facts are noteworthy.

Excepting salt-tolerant groups, the only fresh-water fishes that have entered present Central America are the Ostariophysi, but 13 ostariophysan families have done so. This probably illustrates the advantage of a dominant order in dispersal. Only two of the families, the suckers and the ameaurid catfishes, have entered from the north, and they have reached only Guatemala. Another northern ostariophysan family, the Cyprinidae, has reached southern Mexico. These three families are the only Ostariophysi in North America (excepting the two South American families that just reach its southern edge). They are probably all of Old World origin; the Cyprinidae may not have reached North America until the Miocene. But *all three* families have pushed farther south, toward or into Central America, than any other North American primary-division fishes. They show how dominant families of fresh-water fishes can spread from the Old World, and probably originally from the Old World tropics, through areas inhabited by old, temperate American families, and reach the edge of the American tropics; but all of them have spread widely in the north temperate part of America too. Eleven ostariophysan families have entered Central America from the south, and two of them have crossed the whole length of the existing land bridge to the southern edge of North America.

These facts suggest certain things. Ancient, tropical, fresh-water fishes may have moved through northern areas inhabited by north temperate fishes without displacing the latter: but if they did so, they probably either spread widely in the north temperate zone and will be found fossil there, probably in the Cretaceous, or they followed a route which was more open than now and more differentiated from the main north temperate zone, at least by climate. The present difficulty is in North America. Some tropical Oriental fresh-

water fishes do push up through eastern Asia to the latitude of southern Alaska, and they might reach North America if a moderately warm Bering land bridge existed. Perhaps some ancient fishes did so, and perhaps they found an open route down western North America sometime before the Tertiary. They could probably have crossed a Central American land bridge like the present one, especially if there were no earlier dominant fishes in South America to oppose them. It may be that, during the Tertiary, South America has been a more favorable place for the evolution of dominant stocks of aquatic than of terrestrial vertebrates, and that the fresh-water fishes are more able than most of the rest of the fauna to defend themselves against the invasion of new stocks.

The old South American fauna of fresh-water fishes, the old one of amphibians and reptiles, and the new one of amphibians and reptiles agree in this: all consist or may come to consist of a fraction of Old World stocks that were or are contemporaneous. Since all are the same in this, they may all have been derived in the same way, from the Old World tropics by way of a cool northern filter bridge through temperate Eurasia and North America. I think, then, that at or before the beginning of the Tertiary South America was probably connected with North America, and that for existing cold-blooded vertebrates there is no need of any other old connection. This connection may be the most probable one geologically too. Geological forces in a zone between North and South America have made the new land bridge, and it seems likely that the same forces in the same zone made the earlier one. The question may be left to the geologists. Perhaps the joint science of paleontology will decide the matter. Simpson (1943, p. 420; 1940a, p. 154) finds paleontological evidence that *Testudo* and perhaps also certain mammals reached South America across the sea barrier during the continent's period of isolation. Perhaps it will be found that other animals trickled into South America throughout the Tertiary, and that they followed a persistent chain of islands which were remnants of an old bridge and are parts of the new one.

I have not forgotten the strength of the relationships that exist between parts of the faunas of South America and of Africa. All the strictly fresh-water fishes of South America may be derived from African groups; apparently none, from any North American group; not a single fossil has

yet been found in North America to prove the former presence there of any of the fishes concerned except the Osteoglossidae, which may have been salt-tolerant rather than strictly fresh-water forms; and enough other animals parallel the distribution of the fishes to make it unlikely that the latter's African-South American relationships are due to dispersal through the sea. Fresh-water animals that parallel the distribution of the fishes include not only pipid frogs and pelomedusid turtles but various fresh-water mollusks (Pilsbry and Bequaert, 1927, pp. 598-601). The fact of relationship of a part of the fauna of South America, especially the aquatic part, with that of Africa is beyond dispute. But there are two possible explanations of the fact. One is primarily geological: that great changes have occurred in the continents, and that Africa and South America were once somehow connected so as to allow a simple and direct exchange of life. The other is primarily biological: that geological changes have been slight, and that animals have evolved and spread and competed and receded in complex ways to produce the observed pattern. And whether this explanation is correct or not, dispersal of animals *has* been complex. I think it my function as a biologist to expound the biological explanation and to leave evaluation of the geological explanation to geologists. So throughout this paper I have tried to explain animal distribution in biological terms, without much reference to geology. For example, I have tried to show how Old World tropical fresh-water fishes might have filtered through the north temperate zone to South America (cf. Fig. 5), and I have described an exact route, through eastern Asia, western North America, and Central America; but I have not tried to decide whether this particular northern route is the one most likely to have been open to tropical fresh-water fishes in the late Cretaceous. That is something a geologist should decide. As to a direct connection between Africa and South America, it is my opinion that the biological evidence requires no such connection but does not necessarily forbid it.

In another part of the world, between southern South America and Australia by way of Antarctica or New Zealand, another ancient land connection is sometimes postulated. I shall not try to decide whether this connection really existed, but shall make some comments which concern it (cf. Simpson, 1940b).

The frogs (Leptodactylidae and *Hyla*) and turtles (Chelyidae) that are characteristic of both South America and Australia are all primarily tropical in distribution in South America; all except possibly the leptodactylids are as much tropical as temperate in the Australian Region; and all occur or are fossil somewhere in the northern hemisphere. All may reasonably be supposed to be tropical groups which have dispersed by northern routes.

The amphibians and reptiles of New Zealand are in no case intermediate between South American and Australian forms. New Zealand frogs and *Sphenodon* are not related to anything existing on either continent. New Zealand geckos are endemic genera of a chiefly tropical family. New Zealand skinks belong to a widely distributed genus which occurs in Australia but not in South America.

The only fresh-water fishes with wide Antarctic distributions are forms which enter the sea. The only terrestrial cold-blooded vertebrates with such a distribution are extinct meiolaniid turtles, which occurred in southern South America and in Australia, but which, judging both by analogy with *Testudo* and by occurrence of the meiolaniids themselves on islands, could probably cross sea barriers several hundred miles wide.

One may conclude that there is no good reason to think that any cold-blooded vertebrate has crossed an Antarctic land bridge, but that salt-tolerant fishes and giant land turtles may have dispersed across the water gaps of an Antarctic archipelago under conditions presumably more favorable than now.

Some groups of plants and insects have striking Antarctic distributions: they are common to south temperate South America, New Zealand, and Tasmania and southern Australia, and occur nowhere else. No vertebrates that are closely tied to the land have such distributions. This is sometimes taken to mean that the plants and insects crossed a very old Antarctic bridge before the origin of most existing vertebrates. I doubt, however, if age need be involved. Another explanation might be that plants and insects can persist in small, cold areas where vertebrates, especially cold-blooded ones, cannot. On Tierra del Fuego, for example, there are many Antarctic plants and insects, but no strictly fresh-water fishes at all, probably no amphibians, and only one genus of reptiles, *Liolaeumus*, of the lizard family Iguanidae, a family

which is best developed in the tropics and which, incidentally, does not occur in the Australian Region or New Zealand. By whatever means plants and insects have reached Antarctic lands, the fact

Some of the plants and insects may have dispersed over ocean gaps across an Antarctic archipelago in times of favorable climate. This is a matter for study, not guessing. It calls for study



FIG. 5. GEOGRAPHIC RELATIONSHIP OF AFRICA AND SOUTH AMERICA

This map is a double orthographic projection which shows the main land masses as if the earth were transparent. Solid lines show land on the near side and dotted lines land on the far side of the earth. The map is designed to show not only the relative positions on the globe of Africa and South America but also the position of the northern filter bridge which almost connects them. It emphasizes how high above the tropics animals have had to go to cross from the Old to the New World by a Bering land bridge.

that they can persist there allows them special patterns of distribution. If some of them have dispersed from the Old World tropics, as I suppose cold-blooded vertebrates have done, they have been able to go farther south on the main dispersal lines and have reached and persisted in Antarctic areas.

of the sorts of plants and insects that reach oceanic islands, and for study of dispersal by wind as well as by ocean drift. Chances of wind dispersal cannot be understood without knowledge of the simple principles of air physics (cf. Darlington, 1938, pp. 278-282) and of the wind and storm systems of the world, including the high altitude winds which

blow in different directions and much faster than surface winds.

Concerning ancient climates I have only a little to say. The earth is and always has been a revolving sphere with an equator that receives much heat from the sun and poles that receive little, so the earth's climate must always have been somewhat zonal. Moreover, the earth's axis is inclined so that, as the earth passes around the sun, northern and southern lands have alternate warm and cold seasons which may be even more important than mean temperature in limiting some kinds of life. Within the main zones, climate varies especially with rainfall, which depends on local factors such as the distribution of land and water, the position of mountain ranges, and the direction of prevailing winds. Every existing continent is partly wet and partly dry, and every large continent has probably always been at least wetter in some parts than in others. So zoögeographers may assume some zoning of temperature and some differentiation of local climates at all periods of the earth's history with which they are concerned. Of course local climates have often changed, and even the main zones have varied in intensity and may have shifted position, although the striking differences between north temperate and tropical faunas of fresh-water fishes seem to have existed through the Tertiary and suggest that the zones have not shifted much in that period.

Several times in preceding pages I have mentioned Matthew's ideas (1915), and always to contradict them. I think that he accidentally misstated much of the evidence regarding the distribution of cold-blooded vertebrates and that he should not have tried to force them into his pattern of mammalian distribution. Also I question his theory of the effect of climate on evolution. But I agree with Schmidt (1943, p. 242) that Matthew's analysis of mammalian distribution was enormously important in counteracting a reckless building of land-bridges and in inaugurating a new, more critical, and more logical phase in the study of animal distribution. And I agree with Matthew himself that it is not necessary to remodel the world to account for vertebrate distribution.

CONCLUSIONS, APOLOGIA, AND PROBLEMS

At the beginning of this paper four questions were posed about the pattern of distribution of existing cold-blooded vertebrates. Now I shall try to answer the questions.

What is the main pattern of distribution? It is

partly zonal and partly radial. The zonal elements follow the main climatic zones: freshwater fishes have great, distinct, tropical and north temperate faunas; amphibians, a great tropical fauna and another, less distinct north temperate one; reptiles, a great tropical fauna parts of which extend into the temperate zone, but no distinct north temperate fauna. The radial elements lie irregularly around the Old World tropics.

How has the pattern evolved? Some tropical and north temperate fresh-water fishes may have come independently from the sea. Some other zonal groups offer no clues to their histories. Where clues exist, dispersal seems to have been mainly from the Old World tropics. Apparently successive groups have risen in the Old World tropics, spread radially over much of the world, then fallen into the zonal pattern.

Why has the pattern evolved? Apparently (1) because great groups of animals rise to dominance in the largest and most favorable areas, which for cold-blooded vertebrates are in the tropics of the Old World, and disperse into less favorable climates and smaller areas, their dispersal being facilitated by the ability of dominant groups to enter cold and probably other inhospitable places; and (2) because, after they have dispersed, or during the dispersal of succeeding groups, the older groups tend to fall back into hospitable areas and to become differentiated by adaptation to the main climatic zones of the world.

What does the pattern tell us about ancient lands and climates? It tells of no extraordinary changes: only intermittent land connections between Eurasia and North America, between North and South America, and perhaps between Asia and Australia; and variation in intensity and detail, but not in orientation, of the main climatic zones. But it does not necessarily forbid other connections between continents. And the pattern of distribution of existing cold-blooded vertebrates probably tells nothing of the geography of the world before the later Cretaceous.

These answers have been reached by analyzing, separately, the distributions and apparent histories of fresh-water fishes, amphibians, and reptiles, and finding the common pattern. It was not until I had worked over the fishes and amphibians separately and repeatedly that I saw that there was a common pattern. In tracing the histories, I have tried to use fairly the clues discussed at the beginning of this paper, although space has not always been taken to specify each clue in each case. The

clues, of course, usually indicate apparent histories which are more or less probable but not proved. Perhaps this has not always been sufficiently emphasized. The main pattern of dispersal is an apparent one, derived from many probabilities. But the apparent pattern is common to fresh-water fishes, amphibians, and reptiles, and this fact perhaps strengthens the probabilities in each case.

Of course, the theory developed here is too simple. No animals so old and so diverse as fresh-water fishes, amphibians, and reptiles are likely to have had a simple history of dispersal from one center. Different minor groups must have evolved in many different places and dispersed according to many factors, and dispersal must have involved inconceivably complex advances and retreats, which are considered here in the aggregate. The discussion of such special subjects as evolution and dominance has been drastically simplified too. Dispersal of successive dominant groups of cold-blooded vertebrates from a main center in the Old World tropics is just the outline of a pattern, with a minimum of details.

Many details of the distribution of important groups of animals are still unknown. Here may be mentioned a few that are overdue for attention. Some of these involve taxonomy. The so-called family Atelopodidae (Brachycephalidae) of frogs has been supposed to be confined to America, and was the only amphibian family that seemed to have originated and evolved entirely in the American tropics. Now Davis (1935) has found that an Oriental "*Bufo*" is really an atelopodid, and other Oriental and perhaps African species of this family may really exist. Zoögeographers will be indebted to whoever will compare skeletons of enough species to find out just where the Atelopodidae do occur and how they are related to the Bufonidae. Another case concerns possible relatives of the poisonous American lizards called Gila monsters. *Lanthanotus* of Borneo is usually placed with the Gila monsters in the family Helodermatidae, but it is not poisonous and it is a question how close the relationship really is. Another lizard, *Skini-saurus*, rather recently discovered and known only from the mountainous Yaoshan region of eastern Kwangsi in southern China, is now placed in a family by itself, but, as Loveridge has shown me, it resembles *Lanthanotus* and may be related to it. Both are large lizards, of about a foot in length, rather crocodile-like, with the crest of the tail double near the base. Both are very rare, and the

Museum of Comparative Zoölogy is fortunate to have one specimen of each. Whoever can obtain sufficient material to compare the skeletons of these lizards and determine their relationships will make a real contribution to zoögeography. A more difficult problem is to determine the relationships of various groups of snakes, especially of subfamilies of the dominant Colubridae. The problem has been intelligently attacked (Dunn, 1928; Bogert, 1940; Smith, 1943), but not yet solved. In the meantime, the classification of snakes is partly artificial, and does not give a very sound basis for zoögeographic work. There is in general a need for more and better taxonomic work, and for geographic summaries written by taxonomists. Too many specialists publish important checklists or revisions without such summaries. It would be easy for them to add brief, accurate statements of the geographical distributions of the groups they know so well. May they do so more often in the future! It is hard for a person like myself to dig the information out of the masses of unfamiliar details. Tact forbids the selection of examples for criticism, but one may be cited for praise: Smith's new volumes on reptiles in *The Fauna of British India* include model summaries of the distributions of families and genera.

Some details that need attention are more geographic than taxonomic. The northern limits of various cold-blooded vertebrates in North America are astonishingly little known. Any records of amphibians and reptiles collected above 51° N. in northwestern North America and above 47° N. in the northeast are likely to be valuable. The southern limits of many South American groups are still to be defined, too. And the life histories of both northern and southern species need study.

In other cases the need is for summary or analysis of known facts. The genera and species of North American fresh-water fishes are fairly well known, but there is no good modern summary of their distribution. The fish faunas of South America, Africa, and the Orient have all been better summarized and analysed than that of North America. Of amphibians and reptiles, the Central and South American faunas most need analysis.

Certain parts of the world are due for analysis of their whole faunas. Zoögeographers since Wallace have concentrated on the Indo-Australian Archipelago, with fruitful results. Now it should be Central America's turn. In Central America no less than in Indo-Australia, there are striking differ-

ences in the patterns of distribution of fresh-water fishes, amphibians, and reptiles, and undoubtedly also of mammals, birds, and invertebrates; and the composition and history of adjacent faunas is relatively well known. A thorough analysis of the fauna of Central America and of its history, and a comparison with surrounding faunas, may well yield results of even more importance to zoögeographers, evolutionists, and geologists than the study of the Indo-Australian fauna has done. *Biologia Centrali-Americana* attempted the task too soon. Dunn (1931) and Schmidt (1943) have made a good beginning toward the analysis of what is now known of Central American amphibians and reptiles, but still it is only a beginning.

Of lands that are still likely to yield new animals of zoögeographic importance, Borneo seems to come first. *Lanthanotus* occurs there. So does an *Ophisaurus*, the only anguid known to exist far within the Old World tropics. The discoglossid frog *Barbourula*, now known only from Busuanga Island north of Palawan in the Philippines, and the only known tropical member of its family, may one day be found in Bornean hill streams. If, by any chance, salamanders have existed in the Old World tropics, Borneo is the most likely place for a relict to have survived. New Guinea probably has more undiscovered species and genera of cold-blooded vertebrates, but Borneo is the place to look for relicts that give clues to the histories of families. Of lands that are likely to yield fossils of zoögeographic importance, the tropical Orient is probably first; North America, second.

Certain anomalies of distribution have been disposed of in recent years. Noble (1926) has shown that a supposed Siamese *Ambystoma* salamander and an Abyssinian *Hyla* probably do not exist; they were based on mislabeled American specimens. Myers and Carvalho (1945) have eliminated the supposed La Plata salamander; it appar-

ently really came from California. Dunn (in letter) has seen the type of *Spelerpes infuscatus* Peters, supposed to be from Haiti, and has found it to be a specimen of the Mexican *Oedipus penantulus* (Cope); so there is probably no salamander in the West Indies. Loveridge and Shreve (1947) find that the "New Guinea" snapping turtle is a presumable mislabeled specimen of the common North American snapper; so there is no New Guinea snapping turtle. Some other anomalies are still outstanding. Ahl described a *Hyla* from Java in 1926, apparently without realizing that the locality was surprising. Ahl was responsible for the "Abyssinian" *Hyla*. Is the "Javan" one another mistake? A salamander (*Pleurodeles walli* Michahelles), a *Hyla* (*arborea meridionalis* Boettger), and an emydid turtle (*Clemmys leprosa* (Schweigger)) are all recorded from tropical West Africa south of the Sahara. All are European, and each represents an order or family which does not otherwise occur in the Ethiopian Region. Are the records errors? Or have the animals been introduced by man? Or are they really native in tropical West Africa? Another group of records which needs clarification is that of salamanders in Brazil, even at the mouth of the Amazon (Myers & Carvalho, 1945). *Oedipus* salamanders do occur in parts of the northern half of South America, but records for the Brazilian lowlands are few and not entirely satisfactory. Zoögeographers would like to know just what species occur where, for these salamanders are the only primarily northern, cold-blooded vertebrates which seem recently to have penetrated the tropics so deeply.

ACKNOWLEDGMENTS

I am deeply indebted to Alfred S. Romer, Karl P. Schmidt, and Alfred E. Emerson, who have each read the complete manuscript of this paper and made useful criticisms and suggestions.

LIST OF LITERATURE

- AHL, 1926. Neue Eidechsen und Amphibien. *Zool. Anz.*; 67: 185-192.
- ANDER, K. 1942. Die Insektenfauna des baltischen Bernsteins nebst damit verknüpften zoögeographischen Problemen. *Lunds Univ. Årsskrift*, n.f., Avd. 2, 38 (4): 82 pp.
- BERG, L. S. 1936. [The suborder Esocoidei.] *Bull. Inst. Rech. Biol. Perm*, 10: 385-391. [Russian; summary in English]
- BOGERT, C. M. 1940. Herpetological results of the Vernay Angola Expedition. . . I. Snakes, including an arrangement of African Colubridae. *Bull. Amer. Mus. nat. Hist.*, 77: 1-107.
- CAMERON, A. T., and others. 1947. North West Canadian fisheries surveys in 1944-1945. *Bull. Fish. Res. Bd. Can.*, No. 72: 94 pp.
- CAMP, C. L. 1923. Classification of the lizards. *Bull. Amer. Mus. nat. Hist.*, 48: 289-481.
- COLBERT, E. H., COWLES, R. B., and BOGERT, C. M. 1946. Temperature tolerances in the American alligator and their bearing on the habits, evolu-

- tion, and extinction of the dinosaurs. *Bull. Amer. Mus. nat. Hist.*, 86: 327-373.
- DARLINGTON, P. J., JR. 1938. The origin of the fauna of the Greater Antilles, with discussion of dispersal of animals over water and through the air. *Quart. Rev. Biol.*, 13: 274-300.
- DAVIS, D. D. 1935. A new generic and family position for *Bufo borbonica*. *Zool. Ser. Field Mus. nat. Hist.*, 20: 87-92.
- DE BEAUFORT, L. F. 1913. Fishes of the eastern part of the Indo-Australian Archipelago, with remarks on its zoogeography. *Bijdr. Dierkunde, Amsterdam*, 19: 95-164.
- DOBZHANSKY, T. 1941. *Genetics and the origin of species*. Second edition. Columbia Univ. Press, New York.
- DUNN, E. R. 1925. The host-parasite method and the distribution of frogs. *Amer. Nat.*, 59: 370-375.
- . 1928. A tentative key and arrangement of the American genera of Colubridae. *Bull. Antivenin Inst. Amer.*, 2: 18-24.
- . 1931. The herpetological fauna of the Americas. *Copeia*, 1931: 106-119.
- . 1942. The American caecilians. *Bull. Mus. comp. Zool.*, 91: 439-540.
- EIGENMANN, C. H. 1918. The Pygidiidae, a family of South American catfishes. *Mem. Carnegie Mus.* 7: 259-398.
- EVERMANN, B. W., and GOLDSBOROUGH, E. L. 1907. The fishes of Alaska. *Bull. U. S. Bur. Fish.*, 26: 219-360.
- FISHER, R. A. 1930. *The genetical theory of natural selection*. Clarendon Press, Oxford.
- GILMORE, C. W. 1943. Fossil lizards of Mongolia. *Bull. Amer. Mus. nat. Hist.*, 81: 361-384.
- HERRE, A. W. C. T. 1928. True fresh-water fishes of the Philippines. In *Distribution of life in the Philippines* (Dickerson, ed.), *Monogr. Bur. Sci., Manila*, 21: 242-247.
- . 1933. The fishes of Lake Lanao, a problem in evolution. *Amer. Nat.*, 67: 154-162.
- INGER, R. F., and CLARK, P. J. 1943. Partition of the genus *Coluber*. *Copeia*, 1943: 141-145.
- JORDAN, D. S., EVERMANN, B. W., and CLARK, H. W. 1930. Check list of the fishes and fishlike vertebrates of North and Middle America. . . *Rep. U. S. Comm. Fish.*, 1928, with appendixes, part 2: 1-670.
- LOVERIDGE, A. 1942. Scientific results of a fourth expedition to forested areas in East and Central Africa IV. Reptiles. *Bull. Mus. comp. Zool.*, 91: 237-373.
- , and SHREVE, B. 1947. The "New Guinea" snapping turtle. *Copeia*, 1947: 120-123.
- MATTHEW, W. D. 1915. Climate and evolution. *Ann. N. Y. Acad. Sci.*, 24: 171-318. [Reprinted, 1939, as *Special Publication*, *N. Y. Acad. Sci.*, 1.]
- METCALF, M. M. 1940. Further studies on the opalinid ciliate infusorians and their hosts. *Proc. U. S. nat. Mus.*, 87: 465-634.
- MILLER, R. R. 1946. Distributional records for North American fishes. . . *J. Wash. Acad. Sci.*, 36: 206-212.
- MOORE, J. A. 1942. The role of temperature in speciation of frogs. *Biol. Symp.*, 6: 189-213.
- MULLER, H. J. 1942. Isolating mechanisms, evolution and temperature. *Biol. Symp.*, 6: 71-125.
- MYERS, G. S. 1938. Fresh-water fishes and West Indian zoogeography. *Smithson. Inst. Publ.* 3465, from *Rept. for 1937*: 339-364.
- . 1940. The fish fauna of the Pacific Ocean, . . . *Proc. 6th. Pacific Sci. Cong.*, 3: 201-210.
- . 1943. Rediscovery of the Philippine discoglossid frog, *Barbourula busuangensis*. *Copeia*, 1943: 148-150.
- MYERS, G. S., and CARVALHO, A. L. DE. 1945. Notes on some new or little-known Brazilian amphibians, with an examination of the history of the Plata salamander, *Ensatina platensis*. *Bol. Mus. nac. Brasil*, n. s., Zool., 35: 24 pp.
- NICHOLS, J. T. 1928. Fishes from the White Nile collected by the Taylor Expedition of 1927 [with a tabulation of "the world's fresh-water fish faunae"]. *Amer. Mus. Novit.*, 319: 7 pp.
- . 1938. Classification of carp-like fishes. *Zoologica, N. Y.*, 23: 191-193.
- . 1943. The fresh-water fishes of China. *Nat. Hist. cent. Asia*, 9: xxxvi + 322 pp. *Amer. Mus. nat. Hist.*, N. Y.
- NOBLE, G. K. 1922. The phylogeny of the Salientia. I. . . *Bull. Amer. Mus. nat. Hist.*, 46: 1-87.
- . 1925. The evolution and dispersal of the frogs. *Amer. Nat.*, 59: 265-271.
- . 1926. An analysis of the remarkable cases of distribution among the Amphibia. . . *Amer. Mus. Novit.*, 212: 24 pp.
- . 1931. *The biology of the Amphibia*. McGraw-Hill, New York.
- NORMAN, J. R. 1938. On the affinities of the Chilean fish, *Normanichthys crockeri* Clark. *Copeia*, 1938: 29-32.
- PARKER, H. W. 1934. *A monograph of the frogs of the family Microhylidae*. British Mus. nat. Hist., London.
- . 1940. The Australasian frogs of the family Leptodactylidae. *Novit. Zool.*, 42: 1-106.
- . 1941. The caecilians of the Seychelles. *Ann. Mag. nat. Hist.* (ser. 11), 7: 1-17.
- PILSBRY, H. A., and BEQUAERT, J. 1927. The aquatic mollusks of the Belgian Congo, with a geographical and ecological account of Congo malacology. *Bull. Amer. Mus. nat. Hist.*, 53: 69-602.
- REGAN, C. T. 1905. A revision of the fishes of the family Galaxiidae. *Proc. zool. Soc. Lond.*, 1905 (2): 363-384.

- . 1922. The distribution of the fishes of the order Ostariophysi. *Bijdr. Dierkunde*, Amsterdam, 22: 203-208.
- . 1929. "Cyclostomata", "Selachians", and "Fishes". In *Encyclopaedia Britannica*, 14th edition.
- ROMER, A. S. 1945. *Vertebrate paleontology*. Second edition. Univ. Chicago Press, Chicago.
- SCHMIDT, K. P. 1943. Corollary and commentary for "Climate and Evolution." *Amer. Midland Nat.*, 30: 241-253.
- . 1944. Crocodiles. *Fauna* (Zool. Soc. Philadelphia), 6: 67-72.
- . 1946. On the zoogeography of the Holarctic Region. *Copeia*, 1946: 144-152.
- SCHREIBER, E. 1912. *Herpetologia europaea*. Second edition. Jena.
- SIMPSON, G. G. 1938. *Crossochelys*, Eocene horned turtle from Patagonia. *Bull. Amer. Mus. nat. Hist.*, 74: 221-254.
- . 1940a. Mammals and land bridges. *J. Wash. Acad. Sci.*, 30: 137-163.
- . 1940b. Antarctica as a faunal migration route. *Proc. 6th Pacific Sci. Congr.*, 2: 755-768.
- . 1943. Turtles and the origin of the fauna of Latin America. *Amer. J. Sci.*, 241: 413-429.
- . 1944. *Tempo and mode in evolution*. Columbia Univ. Press, New York.
- SMITH, M. A. 1943. Serpentes. *The fauna of British India, ... Reptilia and Amphibia*, 3: XII + 583 pp. Taylor & Francis, London.
- STEPHENSON, N. G., and THOMAS, E. M. 1945. A note concerning the occurrence and life-history of *Leiopelma* Fitzinger. *Trans. Proc. R. Soc. N. Z.*, 75: 319-320.
- TURBOTT, E. G. 1942. The distribution of the genus *Leiopelma* in New Zealand with a description of a new species. *Trans. Proc. R. Soc. N. Z.*, 71: 247-253.
- WILLIS, J. C. 1922. *Age and area, a study in geographical distribution and origin of species*. Cambridge Univ. Press, Cambridge, Eng.



GERMPLASM, WEISMANN, AND HYDROZOA

By N. J. BERRILL AND C. K. LIU

McGill University, Montreal

THE theory of the continuity of the germplasm, originated and developed by August Weismann during the last two decades of the nineteenth century, has had a pervading influence throughout biology. It has probably been considered to some degree by every biologist, although at the present time its impact differs greatly in the various fields. To many geneticists it still seems to have an odor of sanctity, to most embryologists it has an old-fashioned association with what are now regarded as problems or phenomena of development pure and simple, while many botanists are but vaguely aware that Weismann ever existed. These distinctions are important and reflect the relevance Weismann's theory seems to have as a philosophical concept to the three disciplines respectively. Thus according to the nature of the living material with which one is most familiar, the theory of germplasm continuity may appear to be obvious, plausible, doubtful, or even absurd. Perhaps some of the passion with which it is often upheld by geneticists comes from the suspicion that those who leave the safety of the germplasm fall into the heresy of Lamarckianism.

Strong attacks have at times been made upon the theory. Hargitt (1926), for example, concluded: "I believe biology would be greatly the gainer by dropping the germplasm idea entirely and permanently." Simkins (1923) has been equally condemnatory, but in spite of such efforts the theory always appears to regain strength, as shown by Everett's (1945) recent and ardent support. This vitality may of course flow from truth itself incorporated in the germplasm concept, or it may be a false vitality akin to the walking-dead habits of a Dracula. In either case there is need to re-examine the hypothesis in its original context, to relate its origin to earlier conceptions, for none stands alone, and to trace its later influences in order to understand the present conflict and if

possible therefore to liberate the philosophical spirit of the idea from its mortal substratum.

According to Everett (1945), who expresses a contemporary opinion, Weismann's theory is primarily that there is a clear distinction between the soma and the germplasm, and "the idea that the germ cells early separate from the soma and are unique in that they are the only cells capable of bridging the gap between successive generations has come to be known as the 'germ-track' theory of Weismann. . . . Weismann based his theory upon his work on the Hydromedusae."

These ideas, the abstraction of soma and germplasm, the material basis of the germ-track, and the significance of the Hydromedusae, all merit close examination. While Weismann's investigation of the sex cells in hydroids has been generally held to give substantial support to his theory, actually he himself in his classical work, *The Germ Plasm* (1892), cites it as the source and basis of the entire theory. Accordingly his *Die Entstehung der Sexualzellen bei den Hydromedusen* (1883) becomes the core of the whole argument.

Weismann, it must be remembered, was in his early twenties when Darwin's *Origin of Species* focussed the attention of the biological world, and it was dominant and exciting a few years later in Germany just when he was launching, a little late, on his career as a biologist. He became an ardent believer in and supporter of the theory of natural selection, and later was enormously influenced by the more or less philosophical extensions made by his colleagues, namely, the idioplasm concept of Nägeli, and Haeckel's theory of recapitulation during development. His own rather peculiar theory of evolution was primarily a combination of these three concepts, with subsequent speculation.

It is with this outlook, then, that Weismann came to the study of hydroids, and there is little doubt that he read into his observations ideas that were in a sense already "in the air," for Nussbaum

(1880) was simultaneously developing an essentially similar, though more morphological, theory. In their own way, each of these biologists crystallized the current feeling of their time and cannot be said to have studied their subjects free of preconception. The confusion is profound, for while they did not recognize their own community of interest, and in fact Weismann strongly attempted to refute Nussbaum's conception, it is Nussbaum's form of the theory of germplasm segregation that has had the most influence, support, and defence, though always under the heading of Weismannism.

WEISMANN AND THE HYDROZOA

While Weismann's work on the hydroids is admitted by him and his followers to be the main support of his thesis, it has never been translated into English, and there are actually very few direct references to it by either his supporters or antagonists. Consequently it is necessary to refer to this monograph in much greater detail than might otherwise be necessary.

The first important observation which Weismann made after examining some 35 species of hydroids is that there is a definite relation between the locations of the germ-site (*Keimstätte*), i.e., where the germ cells differentiate, and the status of the sexual generation. He classified the sexual forms into 6 stages exhibiting an increasing degree of morphological regression:

- Stage I. Free-living medusa.
- Stage II. Medusoid with radial canals but no marginal tentacles, usually without velum, sense organs, or mouth opening, and liberating gonads upon separation from the hydroid stock.
- Stage III. Sessile medusoid, radial canal mostly absent or incomplete; subumbrella cavity present.
- Stage IV. Sessile gonophore, wall still with endoderm lamella and two ectodermal layers but no canals and mouth opening; manubrium directly enclosed.
- Stage V. Sessile gonophore whose wall consists of incomplete layers.
- Stage VI. Sporosac, without any trace of medusoid structures.

Likewise, the distribution of the germ site was arranged into 6 stages with increasing order of centripetal shift, i.e., shift toward the proximal end of the colony.

Stage I. Germ site in the ectoderm of the manubrium.

Stage II. In entocodon.

Stage III. In endoderm of gonophore bud.

Stage IV. In endoderm of blastostyle.

Stage V. In coenosarc of lateral hydranth.

Stage VI. In coenosarc of main hydranth (Fig. 1).

It must be agreed that while an exact stage-to-stage correspondence does not necessarily hold, the parallelism between the degree of germ-site shift and that of morphological regression on the part of the sexual generation is quite obvious. The cause of this shift in germ site is interpreted by Weismann as an acceleration of sexual maturity.

As the transformation of the free-living medusa to the sessile sporosac is a matter of phylogenetic retrogression, Weismann immediately attaches phylogenetic significance to the shift of the germ-site. The state of germ-site in those species producing free medusae is taken as the starting point, because in them the medusae have undergone little regression, and their germ-site should most represent the primitive pattern. In nearly all tubularids with free medusa, Weismann finds the germ-site to be the ectoderm of the manubrium (Fig. 1, Stage I). From there on a tendency for precocious differentiation of germ cells prevails. Instead of differentiating after the manubrium is well established (in most cases even after the medusa is liberated from the polyp), the germ cells differentiate in the entocodon (or medusa bell) at a time when the medusoid is yet only a rudiment. This shift (Fig. 1, Stage II) is essentially one of time; the topography is not altered to any appreciable extent, because the inner layer of the entocodon, where the germ cells differentiate, will soon develop into the ectoderm of the manubrium. The further shift of germ site is thought to take place along one of two alternative lines: 1) the germ site is still confined to the ectoderm but retreats into the wall of the gonophore bud; or 2) the germ site is diverted from ectoderm to endoderm of the gonophore bud. Both procedures have been adopted by tubularids as well as by campanularids. Following up the second alternative, one gets Stage III (Fig. 1): the germ site now lies in the endoderm of the gonophore bud. Further intensification results in Stage IV (Fig. 1), for here the germ site pushes back to the endoderm of the blastostyle. Stage V (Fig. 1), with the germ site situated further back in the coenosarc of the lateral

hydranth, is a heterogeneous group with reference to germ layers, because germ cells may differentiate into either ectoderm or endoderm. Finally,

is presumably descended from Stage II through adopting the first alternative and its subsequent intensification.

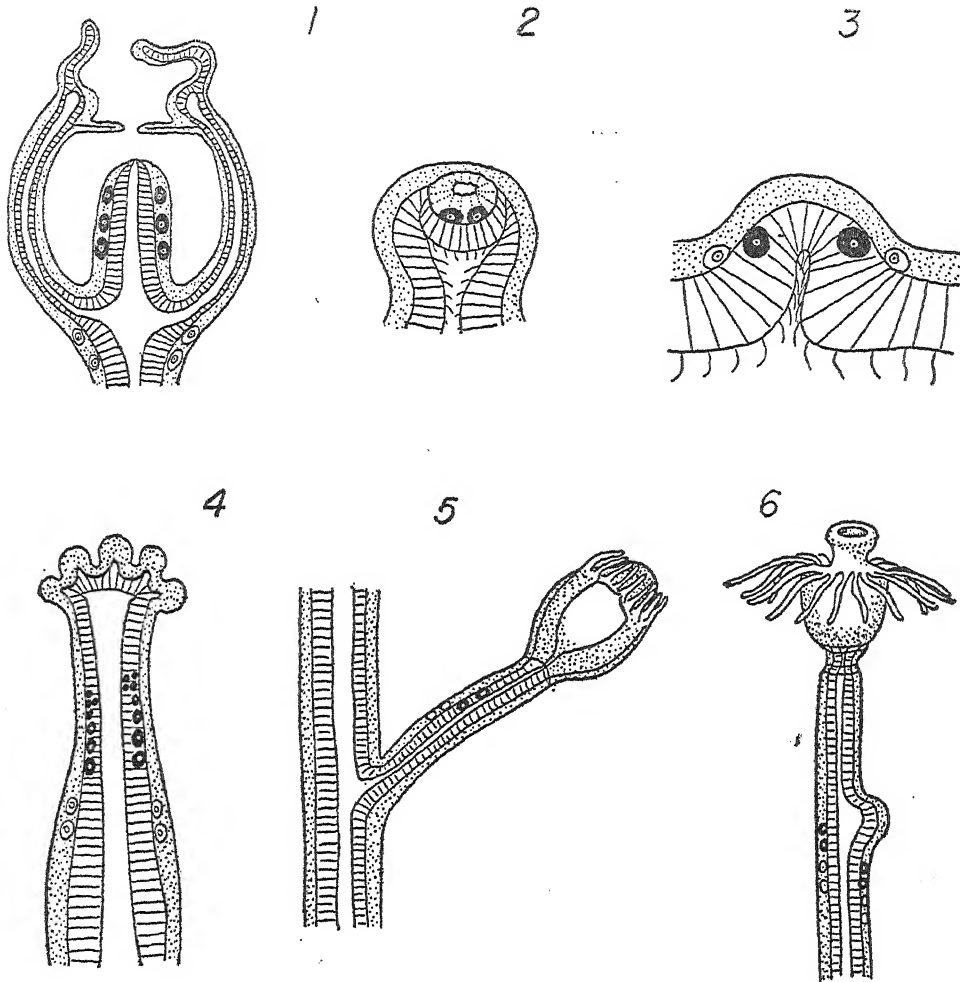


FIG. 1. SIX STAGES IN GERM-SITE SHIFT IN HYDROIDS, AFTER WEISMANN

☞ Ectoderm is stippled, endoderm striated, germ-cells are oval, definitive germ cells black, hypothetical primary germ cells light. 1, Late stage in medusa development with definitive germ cells in ectoderm of manubrium. 2, Early stage in medusa development with the entocodon (or medusa bell) showing central bell cavity, and germ cells segregated within the entocodon. 3, Young stage in development of gonophore (or abortive medusa) with definitive germ cells in endoderm, supposedly having migrated from gonophore ectoderm. 4, A blastostyle, destined to give rise laterally to gonophores, with germ cells present in its wall before the onset of gonophore formation. 5, Germ cells shifted to stem of lateral branch. 6, Germ cells shifted to wall of main stem of hydranth.

the culmination of shift is reached in Stage VI (Fig. 1), where the germ site lies in the coenosarc of the main hydranth. Of all the species Weismann examined, only the female of *Eudendrium racemosum* attains this stage; since in this case the germ cell differentiates in the ectoderm, Stage VI

It should be commented here that while a precocious development of germ cells and a tendency of centripetal displacement of the germ site is an undeniable phenomenon in hydroids, the over-emphasis upon phylogeny alone incurs unnecessary predicaments in explaining many facts which

Weismann confronted, among which the wide difference in germ site frequently occurring between the two sexes of the same species is but one. He interpreted this on the ground of functional utility on the part of the animal.

The significance of the germ-site shift as seen by Weismann, however, did not end here. It remained for two more important observations to complete its implications. The first observation consisted of two items:

1. The germ site is stably fixed at a certain place in a given species (or, in some cases, a given sex of that species). It never varies from one region to another, or one germ layer to another.
2. Histologically differentiated cells never transform into sex cells; only cells of embryonic character can give rise to germ cells.

Putting aside the question whether these two observations are correct or not (which Goette and Hargitt have disputed), it is surprising to see Weismann plunge into the immediate deduction that "not any cell can become a germ cell under certain circumstances, but only those cells that are determined to do so in previous cell generations can undergo this transformation" (W., 1883, p. 226). For this deduction in itself is the keynote of the theory of germinal continuity which he later formulated, in 1885.

The other important observation which Weismann made is that, in sharp contrast to the phylogenetic shift of the germ site, the place where the germ cells mature, the maturation site (Reifungsstätte), is remarkably constant and coincides with the phylogenetically oldest germ site (Germ-site Stage I), i.e., the ectoderm of the manubrium. Even those species with most extensive shift of germ site nowadays still retain their maturation site in the ectoderm of the manubrium.

With (1) the deduction which he obtained from the first observation that only predetermined cells can form germ cells, (2) the fact that germ site varies with species and on the whole exhibits a tendency to centripetal shift, and (3) that the maturation site is nevertheless fixed at the ectoderm of the manubrium, Weismann visualized a migration of sex cells (including primordial germ cells and definitive germ cells) which is the most important theme of his monograph.

The method which Weismann used in constructing his theme is none other than to project phylogeny into ontogeny. In other words, he conceived

the ontogenetic development of the sex cell to be a recapitulation of the evolutionary history. Since in those species with free medusae the ectoderm of the manubrium is at once the germ site and maturation site, he reasoned that the germ cell must have originated there (as primordial germ cell), differentiated there (as definitive germ cell), and matured there. Despite that at the present time the germ site may have shifted to various extents, the primordial germ cell, in view of its predetermined nature, must still arise at the archaic position—in the ectoderm of the manubrium, or of the rudiment which is going to develop into the ectoderm of the manubrium—and it is on this ground that he maintained that the germ cells of hydroids should be always ectodermal in origin, no matter whether they differentiate in the ectoderm or in the endoderm.

Since the primordial germ cells have arisen from the ectoderm of the manubrium, they must have undergone a migration so that they could reach the new germ site where they are to differentiate into germ cells. This constitutes one phase of the migration. The other phase is the migration of the germ cells from the germ site to the maturation site; it seems that a migration of this kind is inevitable if the germ cell which has been differentiating at some other place is eventually to lie in the ectoderm of the manubrium, as already mentioned. The two phases of migration could be considered, therefore, as the efferent and afferent paths of the sex cells with reference to the definite maturation site. Accordingly, Weismann stated that there is no migration in species whose germ site is also the maturation site, as is the case with those giving free medusae. Nor is a migration to be expected in forms which have the germ site in the entocodon, such as *Tubularia* (W., 1883, p. 219), because the germ cell is driven to the final position simply by the formative force of the gonophore bud (W., 1883, p. 270). Once the shift of germ site carries beyond Stage II (Stages III, IV, and V), an active migration of the primordial germ cells becomes necessary, and in migrating they work their way through the mesolamella to reach their germ site, only to penetrate the mesolamella once again later on, this time as definitive germ cells, in order to return to the age-old site of maturation. Moreover, even in the case where the germ site shows an extensive shift yet is still confined within the ectoderm (Stage VI), the germ cells on their way back must nevertheless break

through the mesolamella twice, first entering and then quitting the endoderm, to reach the homologous layer of the ectoderm of manubrium.

As to identity of the primordial germ cells, Weismann indicated that they are a kind of embryonic cells which give rise to germ cells. He admitted, however, that there is no morphological distinction between the primordial germ cells on the one hand, and other embryonic cells on the other. The primordial germ cells therefore have no morphological characteristics of their own. What makes them primordial germ cells is that they, and only they, can give rise to germ cells. This criterion, however, is taken for granted by Weismann as the deduction of his two observations. It has been shown that this deduction is logically unsound, even if the premises be correct. The investigations of Goette (1907) and Hargitt (1919), furthermore, revealed facts which are incompatible with these premises. The presence in the hydroids of a kind of primordial germ cell, in the sense of Weismann, is therefore purely imaginary and not supported by evidence of any kind in his original paper.

As a proof of the migration of the supposed primordial germ cells, Weismann presented the evidence he found in *Podocoryne*, *Hydractinia*, and *Pachycordyle*. In *Podocoryne*, in the young gonophore not yet containing any egg or having only a very few small eggs, separate cells may be seen in the ectoderm, larger than the rest, with a somewhat large, light nucleus and a deeply stained nucleolus. Sometimes these cells are seen to be applied closely to the mesolamella. Similar cells, separate or in groups, may be found on the other side of the mesolamella, in the endoderm, thus indicating that they have migrated from the ectoderm. These cells later develop into eggs.

In *Hydractinia* as well as in *Podocoryne*, where Weismann made particularly detailed observations, neither in the female nor in the male does the germ cell originate through transformation of the differentiated endoderm cells. Since the endoderm could not form germ cells, and yet germ cells are formed in the endoderm of these species (female at least), they must have migrated from the ectoderm. In *Pachycordyle*, where the spermarium (only the male is known) is found to mature in the spadix (the maturation site is accordingly in endoderm and hence an exception to the general rule), cells similar to those constituting the spermarium are found in the ectoderm. Weismann considered

this to be a strong morphological proof of a migration from the ectoderm.

Of this evidence, the first (from *Podocoryne*) and the third (from *Pachycordyle*) support the same line of argument, namely, the presence in the ectoderm of cells similar in appearance to the developing germ cells in the endoderm. When his original drawing of *Podocoryne* is consulted, it will be found that the ectoderm cell which he labels (*ekt'*) and states in the legend to be similar to the developing eggs in the endoderm bears little resemblance to the latter (W., 1883, Pl. 19, fig. 18), and to link them is rather far-fetched. The said ectoderm cell could well have been an interstitial cell. His drawing for *Pachycordyle* (W., 1883, Pl. 6, fig. 6) shows the primordial germ cell (*ukz*) similar to the developing male germ cell (*kz*) of the endoderm, but here the male germ cell shows resemblance to the ordinary ectoderm cell (*ekt*) just as well. It is obvious from his drawing that he was dealing with an interstitial cell again. Since interstitial cells have been reported to be present in both ectoderm and endoderm (Hargitt, 1919), the assumption of a migration becomes completely unnecessary.

The second evidence has been shown to rest on a false premise. Goette (1907) and Hargitt (1909, 1919) found numerous cases where division of an endoderm cell results in the formation of two cells, one of which becomes a germ cell while the other persists as an epithelial cell, thus supplying the facts demanded by Weismann himself, in the following words, to prove his contention incorrect:

"The egg in no case arises from accomplished endoderm cell; indeed, the cells from which the eggs differentiate lie long before at the depth of the endoderm which is otherwise single-layered. If the eggs were of endodermal origin, so they would have to arise from division of ordinary endoderm cells; and it would follow that, turning toward the gastrocoele, the distal half remains epithelial cell, the basal half becomes germ cell. Nothing has been proved of such division . . ." (W., 1883, p. 237).

"Such being the case, no explanation for the displacement of germ site from the ectoderm to the endoderm other than the one assumed before could exist, namely, a migration of the primordial germ cells from the ectoderm into the endoderm. In *Podocoryne* the male germ site today lies in the ectoderm of the manubrium; the female, however, in the endoderm of the gonophore bud. When once it is established that the latter position is derived from the former, how otherwise could one explain that suddenly cells of endoderm took over the functions which previously were possessed by

those ectoderm cells? It would be a different matter if in some species it occurred that germ cells differentiate at indiscriminate places in the stalk, now in ectoderm, now in endoderm. But this never occurs; of all the data communicated above it is evident that the germ site of present-day species is rigidly localized, and what else can this mean other than that certain cell generations alone possess the ability to produce sex cells, that a strict law of heredity governs here and nothing is arbitrary and accidental? How, then, under such circumstances could the endoderm cells of a gonophore bud take over the inherited properties of the ectoderm cells of the same bud? A long series of cell generations separates two cells, one of which originated from ectoderm cells, the other from endoderm cells lying on the other side of the mesolamella; they are connected only at the root of the whole polyp stalk; in other words, in the cleavage process of the egg, from which the first hydranth and colony originate. How and whereby could it become possible that suddenly the endoderm cell should differentiate into sex cells as the ectoderm cell has hitherto done? It is no exaggeration to regard this as impossible. When certain cells of the endoderm of the gonophore bud show the ability to differentiate into germ cells, the conclusion is undeniable that they must have migrated from the ectoderm, whether this be confirmed by observation or not." (W., 1883, p. 288).

In the above passage we can see that the basis for such an idea of migration is the supposed ectodermal origin of the primordial germ cells, an idea which in turn is based on the doctrine of recapitulation, in its original form now greatly discredited (DeBeer, 1940). But it is primarily on the basis of strict recapitulation that Weismann propounded the migration of primordial germ cells, to which he so stubbornly adhered that he seemed to have defended it to the extent of disregarding the truth. His interpretation of the germ cell origin of *Coryne* (W., 1883, p. 238) serves to illustrate how far imagination can be pushed to suit a preconceived idea. In this hydroid the germ cells arise from the entocodon, which he observed. In contrast to the entocodon of most hydroids, that of this genus is formed of endoderm instead of ectoderm, which he also admitted. However, he contended that the endodermal entocodon of *Coryne* must have descended from the phyletically old ectodermal entocodon, because *Syncoryne* is the nearest relative of *Coryne*, and it has the usual ectodermal entocodon. His interpretation of the formation of this endodermal entocodon was that, in this case, not only the primordial germ cells but all cells which would normally constitute the entocodon

have become detached from the ectoderm together and have invaded the endoderm, only to rebuild there an entocodon just like the true ectodermal one (W., 1883, p. 238).

Both the preconceptions of migratory germ cells and primary segregations of germ sites have persisted for more than half a century, profoundly influencing the ideas and interpretations of subsequent workers. Recently, for example, Dupont (1942) has described the origin of germ cells in the hydroid *Tubularia* as follows. The entocodon is of ectodermal origin but sinks to form an ectodermal subumbrellar mass upon the underlying endodermis. The germ cells, also ectodermal, have an origin independent of the entocodon, and arise from interstitial cells that glide across the mesogloea into the endoderm in a sudden and fleeting movement and scatter among the bases of the endodermal cells. They then leave the endoderm and concentrate beneath the subumbrellar layer of the entocodon, without however penetrating into it. This, in our opinion, is a highly erroneous account, obviously inspired by Weismannian preconceptions, and with nothing in common with the much simpler and observable sequence of events described elsewhere for this same species (Liu and Berrill, 1948).

Weismann himself went on to say that "a given germ cell of the coenosarc migrates only to a determined gonophore," that each individual germ cell acts as an independent being which "strives for a definite aim," and exhibits "historical reminiscence" (W., 1883, p. 290). Paradoxically, however, he made it very clear that the germ cells of the hydroids arise late in their life cycle, as descendants of ordinary young tissue cells, and in no case are special cells set apart in early embryonic stages for that purpose (W., 1883, p. 279). He himself also refuted the idea of Nussbaum (1880), who maintained that germ cells are separated from the remaining cells in a very early stage before any histological differentiation takes place, a view which Weismann's over-enthusiastic followers have nevertheless tried to defend in vain.

Weismann's negation of Nussbaum's idea only made the issue more subtle. For basically, he and Nussbaum believed in the same principle, that there is a fundamental difference between the "sex molecule" on the one hand and the "somatic molecule" on the other hand. The discrepancy in their views only relates to the time for the expression of the "sex molecule." While Nussbaum contended

for the early separation and consequently absolute independence of sex cells as the germ layer, Weismann contested that the sex molecule may mix with soma for a long time before it splits off as the germ layer. Since on this view the sex molecule could occur in a diffuse state and intermingle with the soma, the same principle is rendered much less vulnerable to attack in Weismann's version than in Nussbaum's. As to why the sex molecule should lie diffuse in the somatic cells for a considerable number of cell generations, Weismann suggested that a general advantage of this kind is to enhance the propagative capacity of the individual which arises from the fertilized egg. In animals with alternation of generations this advantage is especially apparent, inasmuch as numerous individuals can be brought forth from a single egg.

Such, in broad outline, was Weismann's investigation of the sex cells of the hydroids. An analysis reveals that he had leaned overmuch upon the theory of recapitulation, and had too few facts to warrant his conclusions. Supposition upon supposition makes up the hypothesis of germ-site shift, which was then taken as evidence for his theme in his subsequent work (Weismann, 1892, p. 189).

While it is primarily Weismann's concept that there is a fundamental distinction between germ-plasm and soma, it is due mainly to Nussbaum that this separation has come to imply an actual segregation of the two types of tissue at an extremely early developmental stage, and also to the spectacular factual support by the description of germ-cell segregation in *Ascaris* (Boveri, 1899). Many similar cases, though rarely so extreme, have been discovered, but they are few in number compared with those organisms that exhibit no obvious segregation. The weight of authority, however, of the Weismann - Nussbaum combination convinced many later workers of the existence of facts they could not observe, and much subsequent argument has arisen over the identity of so-called primordial germ cells and the existence of a germ-track in developmental stages younger than those in which germ cells can be safely recognized. Two misconceptions have frequently arisen, that a cell must be a germ cell because of theoretical requirements in spite of contrary or ambiguous histological evidence, and that in organisms that produce asexually a series of non-sexual, sexually immature, and finally mature sexual forms, the germ cells migrate

from one generation to the next, becoming progressively more mature with each migration.

In many cases, for example, the origin of the germ cells in hydrozoa has been traced back to the interstitial cells (Wulfert, 1902; Harm, 1902; Downing, 1905; Brien, 1942). But once the primordial germ cell merges its identity with the interstitial cell, any argument about a germ-track or about the nature of the primordial germ cell becomes futile. Since an interstitial cell can give rise to many different types of cell besides the germ cell, it is always in doubt whether the cell is a presumptive germ cell or something else. Identification of certain interstitial cells as primordial germ cells has already been judged to be subjective and unwarranted (Wager, 1909; Tannreuther, 1909), although recently Brien (1942) claims both identity and migration in the case of *Clava*. In fact the whole question of interstitial cells and their significance in the Hydrozoa merits an intensive review and reinvestigation, and there is little doubt that their role has been grossly overestimated.

A good example of the other type of illusion is afforded by Pizon's (1893) monographic account of blastogenesis in *Botryllus*. In the early bud generations no gonads are visible, in later ones small immature ova are to be seen, while in large colonies the buds carry ova that grow and mature to become viable eggs. Believing was seeing, and since the germ track was known to exist in consequence of Weismann's and Nussbaum's authority, germ cells were present but unrecognisable in the oozooid, and passed from one bud generation to another until they became discernible and finally matured. This was a completely erroneous description, for each bud develops its own gonads to whatever extent is permitted by the initial size of the bud (Berrill, 1941).

The germ track, in fact, became a morphological concept that has distracted many workers from looking at phenomena as they are, misdirecting them from the basic problem of precocious histogenesis and induction that is so well presented by developing gonads. To indoctrinated sophisticates the monumentally simple or obvious, always difficult to see, becomes unnecessarily obscure, for "except ye be as little children, ye shall in no wise enter the kingdom of heaven."

Should the idea of germplasm be discarded even by those to whom the intellectual or emotional appeal is intense? To a considerable extent it is a matter of definition. It should be remembered

that the concept was developed at a time when eggs alone were seriously considered as the source of new organisms, and when the modern genetical understanding of nuclear constitution was a thing of the future. Most, if not all, of the controversy comes from the identification of the germ cells as the bearers of heredity, and the consequent significance of the continuity of the germ line through successive generations. This continuity is no longer of vital importance and a moderate shift in emphasis makes it possible to avoid the whole issue.

The change in point of view is a double one. The germ cells, and the ova especially, are highly developed and to some extent specialized cells elaborated primarily in connection with the mechanics or physiology of development, and not as bearers of heredity, although they have become so exploited. As a sacred image remote from the somatic multitude they have little meaning. On the other hand, the significance of the unspecialized cell whose descendants can become eggs or nematocysts in the case of hydroids, and nerve cells or spermatozoa in ascidians, becomes greatly enhanced. Among invertebrates and lower vertebrates where tissue and cell specialization is less extreme, tissues consisting of unspecialized cells in epithelial formation abound, and regeneration experiments of the past several decades have shown that such cells are usually totipotent, having the innate capacity to give rise to any specialized tissue, including the gonads themselves. In other words the germplasm, if there be need for this abstraction, may be identified with any cell or cells that have not become specialized to any significant degree, cells with complete and unmodified nuclear constitution and with cytoplasm not so specialized either structurally or chemically as to be limited in its potentialities. Such cells may be large and highly elaborated in a general way, like the endodermal cells of hydroids, or may be small and little developed, as in the septal cells of annelids. In a more striking form they are found throughout the plant kingdom where most green cells with their cellulose wall, large vacuole and complex chloroplast, can under certain circumstances give rise to the complete plant. It is no wonder that germ site, track, and plasm are here alien sounds from a forgotten past.

We may end with reference to the most recently published account of germ cell origin in hydroids,

that of Brien (1943). He concludes by stating that "*l'évolution du germen en soma est réversible. De plus la lignée germinale est discontinuée. . . Il n'y a pas de dualité chez un métazoaire. L'organisme métazoaire est un tout en ses fonctions et ses structures.*" Germplasm, if the term is to be kept at all, can therefore be retained only as a pure abstraction, philosophically valuable but otherwise distracting. In our opinion it is better to dispense with it altogether than to continue to encourage its misuse.

CONCLUSION

In conclusion, Weismann undoubtedly had great insight into certain major problems of his day and in boldly challenging the Lamarckian principle and Darwin's related theory of pangenesis did much to bring the study of heredity into closer relationship with cytological research; and in emphasizing inheritance as the descent from a pre-existing germ cell and not from the parental body as a whole, he cleared the ground for the rise of genetics a decade or so later. His distinction between "germplasm" and "somatoplasm," while drawn much too sharply and in our opinion misleading, was a logical outcome of his belief in qualitative nuclear division as the primary determination of development of the egg.

Most embryologists now believe that fundamentally any cell may be totipotent, and contain the heritage of the species, and that limitations of potency are due to secondary inhibitory conditions. Though the trail of descent is still from zygote to zygote, it is in each generation broken through a short or long path of somatic cells. Germplasm becomes the essentially unmodified cell of the species, and the female germ cell is only one example, even though the type carrying the main burden. In recognizing the significance of the cell in inheritance, the concept remains philosophically important, but in confusing the abstraction with the morphological germ cell Weismann, and his followers especially, have created unnecessary difficulties. Our main criticism however remains, that ideas which Weismann arrived at intuitively or by induction from various sources, blinded him in his studies of hydroids and caused him to see imaginary migrations of visible and invisible germ cells, and that whatever the intrinsic merit of his ideas, they are not based upon the study to which they are credited.

LIST OF LITERATURE

- BERRILL, N. J. 1941. Size and morphogenesis in the bud of *Botryllus*. *Biol. Bull.*, 80: 185-193.
- BRIEN, P. 1942. Études sur deux hydroides gym-noblastiques, *Cladonema radiale* (Duj) et *Clava squamata* (O. F. Müller). *Mem. Acad. Roy. Belg.*, 20: 1-116.
- . 1943. Études de la régénération et de la rénovation de l'appareil sexuel chez les Hydroides (*Clava squamata* O. F. Müller). *Arch. Biol.*, 54: 409-475.
- BOVERI, T. 1899. Die Entwicklung von *Ascaris megalocephala* mit besonderer Rücksicht auf die Kernverhältnisse. *Festsch. Kupffer.*, Jena.
- DE BEER, G. R. 1940. *Embryos and Ancestors*. Oxford Univ. Press, London.
- DOWNING, E. R. 1905. The spermatogenesis of *Hydra*. *Zool. Jahrb., Abt. Anat.*, 21: 379-426.
- DUPONT, M. 1942. Origin des cellules germinales et formation du gonophore chez les Tubulaires. *Arch. Biol.*, 53: 493-511.
- EVERETT, N. B. 1945. The present status of the germ-cell problem in vertebrates. *Biol. Rev.*, 20: 45-55.
- GOETTE, A. 1907. Vergleichende Entwicklungs-geschichte der Geschlechtsindividuen der Hydropolypen. *Z. wiss. Zool.*, 87: 1-335.
- HARGITT, G. T. 1909. Maturation, fertilization and segmentation of *Pennaria tiarella* and of *Tubularia crocea*. *Bull. Mus. comp. Anat. Harvard*, 53: 161-212.
- . 1919. Germ cells of coelenterates. II. Gen-eral consideration, discussion, conclusion. *J. Morph.*, 33: 1-59.
- . 1926. The formation of the sex glands and germ cells of mammals. *J. Morph.*, 42: 253-294.
- HARM, K. 1909. Die Entwicklungsgeschichte von *Clava squamata*. *Z. wiss. Zool.*, 73: 115-165.
- LIU, C. K., and N. J. BERRILL. 1948. Gonophore formation and germ cell origin in *Tubularia*. *J. Morph.*, (in press).
- NUSSBAUM, M. 1880. Zur Differenzierung des Ge-schlechts im Tierreich. *Arch. mikr. Anat.*, 18: 1-121.
- PIZON, A. 1893. Histoire de la blastogénèse chez les Botryllidés. *Ann. Sci. nat.*, (7) Zool., 14: 1-386.
- SIMKINS, C. S. 1923. On the origin and migration of the so-called primordial germ cells in the mouse and the rat. *Acta Zool.*, 4: 241-284.
- TANNREUTHER, G. W. 1909. Observations on the germ cells of *Hydra*. *Biol. Bull.*, 16: 205-209.
- WAGER, H. E. 1909. The oogenesis and early de-velopment of *Hydra*. *Biol. Bull.*, 18: 1-38.
- WEISMANN, A. 1883. *Die Entstehung der Sexual-zellen bei den Hydromedusen*. Gustav Fischer, Jena.
- . 1892. *The germ plasm*. English translation by W. N. Parker and H. Rönfeldt. Scribners, New York.
- WÜLFERT, J. 1902. Die Embryonalentwicklung von *Gonothyraea loveni*. *Z. wiss. Zool.*, 71: 296-327.



NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Assistant Editor of THE QUARTERLY REVIEW OF BIOLOGY, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.

REVIEWS AND BRIEF NOTICES

General Biology: Philosophy and Education.....	133	Animal Morphology.....	164
Biology: History and Biography.....	137	Animal Growth and Development.....	167
Ecology and Natural History.....	140	Animal Physiology.....	170
Evolution.....	141	Animal Nutrition.....	171
Genetics and Cytology.....	147	Biochemistry.....	172
General Physiology.....	149	Microbiology.....	174
General and Systematic Botany.....	150	Parasitology.....	177
Economic Botany.....	151	Health and Disease.....	178
Plant Morphology.....	152	Psychology and Animal Behavior.....	182
Plant Physiology.....	153	Human Biology.....	188
General and Systematic Zoology.....	153	Biometry.....	194
Economic Zoology.....	159	De Omnibus Rebus et Quibusdam Aliis.....	195

GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

ON UNDERSTANDING SCIENCE: *An Historical Approach. The Terry Lectures.*

By James B. Conant. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. \$2.00. xvi + 145 pp.; text ill. 1947.

This book calls to mind another written long ago, at a turning point in the teaching of medicine in this country. Conant's book lacks the massive documentation of Abraham Flexner's famous report on *Medical Education in the United States*, but it promises to be equally influential. It is equally packed with radical ideas and searching criticisms, in this instance ideas concerning the usual approach to the teaching of science qua science. Again like Flexner's report, this volume appears at a time when change is in the air. It is a part of the scholastic ferment that has resulted in the Harvard Report, the various "Great Books" programs, and other such manifestations.

In the words of Conant himself, "the fundamental premise of this book" is that for the prevalent bewilderment about the nature of science "the remedy does not lie in greater dissemination of scientific information among nonscientists. Being well informed about sci-

ence is not the same thing as understanding science, though the two propositions are not antithetical. What is needed are methods for imparting some knowledge of the Tactics and Strategy of Science."

In his first chapter, Conant develops this basic premise with arguments at once powerful and persuasive. This is not to say that no one will take exception to any of the statements made there, but the main contentions will carry a large measure of conviction. Especially will this be true among those biologists who have heard otherwise mature students talking about science as though it were a revealed religion to be accepted and learned, or who have looked into elementary textbooks and laboratory manuals that are primarily compilations of didactic laws and compacted facts. Conant leaves little doubt that such things are part of science but not the core. "To give a better understanding of science," he says, "to those of our graduates who are to be lawyers, writers, teachers, politicians, public servants, and businessmen," it is not enough to present an array of discoveries in nuclear physics, biochemistry, or astronomy, however recent and dazzling. Nor is the dissection of one more animal nor the carrying out of one more experiment in chemistry the answer. Still less is it the most perfect presentation of the most perfectly

organized science complete and rounded from the all-inclusive law down to the smallest fact. On the contrary, it is the contention here that emphasis should be upon those features that distinguish science from dogma and give to science its unique power.

To implement his proposal, Conant suggests a special course built around the "case method" long in successful use in law schools and schools of military tactics and strategy. The second chapter is devoted to a detailed consideration of the 17th century investigations into air pumps, barometers, and vacua by Galileo, Torricelli, von Guericke, and Boyle, as illustrations of four principles of scientific discovery. Not only are the successes discussed, but also the errors made and difficulties met, the blind alleys and pitfalls, all of which are equally important from the point of view of such a course. The chapter ends with a brief but suggestive section on the interrelationships between science and society. The proposed study of Puritan Oxford and Catholic Florence as two contemporary centers of important scientific advance should be good medicine for the man liable to slip into easy generalization in this important field wherein everyone has opinions.

The third chapter deals with two case histories drawn from the 18th century, the discovery of the electric battery, and the chemical revolution which replaced the phlogiston theory of combustion by an even more fruitful theory. Numerous additional principles of scientific discovery are illustrated and discussed. The book closes with a brief chapter in which twenty-one "principles of the Tactics and Strategy of Science" are summarized. Another man would certainly have ended with a different number, but that is unimportant.

If there is to be any protest against the main argument of the book, it will probably not come from experimental scientists so much as from professional philosophers. For one thing, the latter are specifically tossed out the window as incompetent to interpret science, at least to a non-philosopher. Perhaps this opinion results from the prominence they have given to Karl Pearson's and Ernst Mach's views on the nature of science, views which Conant shows to be not merely inadequate but in fact downright misleading. Greater familiarity with Pearson's friend and contemporary, W. K. Clifford, or with Bertrand Russell or Henri Poincaré might have given experimentalists and laymen alike a clearer view. But scientists have often been leary of philosophers. One is reminded of the great controversy in Soviet Russia some years ago in which so many experimental scientists, including Timiriazev, the son of the famous plant physiologist, lined up as pedestrian "mechanists" against what they felt were the dizzy flights of Hegelian dialectical materialism. Conant wisely suggests that the extent to which such a course as he advocates should take cognizance of the existence of problems in metaphysics and epistemology would depend upon the out-

look of the instructor and the interest and maturity of the student. In fact, he suggests that some collaboration with a philosopher might be desirable at this point after all. "Obviously the course in question would not be one on the metaphysical foundations of modern science." And obviously, we are getting close to very deep waters.

"No one," says Conant in conclusion, "can be a dogmatist about a course which has never yet been offered. I can only hope that a group of skillful teachers may in different colleges find some merit in my proposal."

GAIRDNER MOMENT



CRITICAL THINKING: An Introduction to Logic and Scientific Method. Prentice-Hall Philosophy Series.

By Max Black. Prentice-Hall, New York. \$3.75. xvi + 402 pp.; ill. 1946.

As the subtitle implies, this is an introductory textbook on logic and scientific method. It is divided into three parts, dealing respectively with deductive logic, language, and induction and scientific method. For a student of the sciences, the contents are well-balanced, since nearly one half of the book is devoted to the last topic.

The reviewer's experience with logic as an academic subject is extremely limited. But he remembers with considerable distaste his formal training in this subject and the text that he used. It was dry and artificial. Most of it was concerned with an examination of syllogistic arguments in their various ramifications, and any resemblance between the arguments presented and arguments in real life was largely accidental. Since then, the reviewer has seen others equally as bad, and it has always seemed unfortunate that so vital a subject should have been condemned to textbooks so dead.

This textbook, however, is a welcome change. It is interesting. The author has drawn heavily upon biographical material, newspaper stories, joke books, and even the Congressional Record, to illustrate his points. He makes use of stylized cartoons to dramatize the conditional argument. Each chapter ends with a series of exercises made up of the kinds of statements and arguments we hear and use constantly. The result is a book on logic that is alive and real. Logic becomes something not just to study but to use in everyday life. This does not mean that the text is light. The treatment appears to be fully as rigorous as is found in other introductory works, and the reader will have to take it in small doses. But without sacrificing content, the author has written an enjoyable book.

This text should be eminently satisfactory for introductory collegiate courses in logic. The reviewer wishes that he had had it when he studied the subject.

A. CHAPANIS

MORALE DE SAVANTS: *D'Hippocrate à Einstein*. Collection Lebègue, 7th Series.

By Jean Pelseneer. Office de Publicité, S. C., Bruxelles, Belgium. 25 fr. (paper). 129 pp. 1946. The problem of whether a kind of ethics can be developed on a purely scientific basis was raised a few years ago in this country by Chauncey D. Leake in his *Ethicogenesis*, and a considerable discussion ensued. The present little source book on the ethics of scientists, published in the excellent Belgian Collections Lebègue and Nationale—why don't we have such handy, cheap, and competent series on all aspects of our culture?—shows that the same problem, very acute in the 18th and 19th centuries, is still discussed in Europe. The editor refers rather lengthily in his introduction to a book of Albert Bayet entitled *La Morale de la Science* (Paris, 1931). Adopting the Bayet-Leake point of view, Pelseneer has set out to document it.

That this source book draws primarily on French sources is rather natural. It has the shortcomings of all source books: too many of its selections are too short to be really significant. Still, Descartes, Réaumur, Lamarck, Benjamin Thompson, Arago, and Quetelet are represented by selections of sufficient length to be meaningful. Berthelot, H. Poincaré, Painlevé, Charles Nicolle, B. Russell, and Einstein are quoted in even greater length. A few selections like Franklin's letter to Lord Howe seem really unrelated to the subject matter.

Quite independently of whether ethics can actually be derived from science or not, scientists ought to be aware of ethical obligations and to know the admirable ethical precepts of the great protagonists of science. This book, bringing the latter into easy reach of the busy scientist, can therefore be most warmly recommended.

ERWIN H. ACKERKNECHT



ON THE RESOLUTION OF SCIENCE AND FAITH.

By Wendell Thomas. Island Press, New York. \$3.50. xii + 300 pp. 1946.

Few books on the resolution of science and religious faith display the depth, vigor, or courage of this one. The author is possessed of a broad knowledge of each of the three fields—philosophy, religion, and science—which he here endeavors to unite in a synthesis.

The first part of the book, entitled, Exploratory, is a penetrating analysis of the history of monism through the centuries. Wendell Thomas begins with Anaximander's *to apeiron*—"the boundless"—which the author interprets as space, not empty space, but space the "source, ground, and goal of all activity," the underlying reality out of which all things come, the boundless material soul of the universe. This is the author's basic idea and his ultimate identification of God. Through

the ideas of the later Greek philosophers he traces the emergence of dualism into Western thought and its struggle with monism. Beginning with the contributions of the religion of Jesus and the Hindu Vedanta to this struggle, he follows it through Thomas Aquinas, Spinoza, and George Fox to Sir Isaac Newton, in whose thinking the combination of science and faith attained a new, yet still incomplete, solution. The contributions of Kant, Hegel, Marx and Engels, John Dewey and the modern realists, and the non-dualistic, non-deterministic evolutionists such as Lloyd Morgan are added to the analysis.

The author thus comes to Part Two, Analytical, in which he considers the scientific views of the nature of space, time, and the cosmos. Part Three, boldly titled Constructive, discusses the nature of a scientific faith. A table (p. 180) that considers God as material, efficient, and final cause in the concepts of physics, psychology, and value theory respectively, sums up the author's monistic theism, and is well worth study. Chapters with challenging titles follow: What Psychology and Physics Can Share; Theology as Fundamental Science; The Needlessness of Doctrinal Problems.

Next comes a consideration of biological questions in relation to the author's conceptions: Can Life Come from Matter?; Evolutionary Surprises; Is Man Unique in the Cosmos?; Mankind Is Still Emerging. One need only emphasize that Wendell Thomas sees the weaknesses in both vitalistic and mechanistic views of nature, and that his grasp of evolutionary fact and theory outclasses that of Lecomte du Nöuy (*Human Destiny*). One may forgive a non-biologist for too implicit a trust in such false guides as George Crile. On the whole, the author picks and interprets his sources of biological information very well.

The book ends with a consideration of The Threefold Task of Social Science: "to outline through history and its ideal projection the values at which man, both 'individually' and collectively, should aim; to discover through psychological study how man might be induced to attain these valued objectives; and to analyze through sociology the human material, or social structure with which we must deal." The fulfilment of these tasks is seen in the view that "creative life, or progress, is not a one-way affair; it is cosmic reciprocity in which man, who is master, is the servant of all. The function of man in the earthly kingdom of God is mediate, focal, coordinating, like that of the nervous system."

Well-written, this book is nevertheless not easy reading, for its thought is closely knit. The scientific portions will likely seem as difficult to a philosopher as the philosophical portions appear to a scientist. The book may find few readers, but it demands respect. It is well documented and has a rich bibliography. It has a timeless quality, and its audience should grow through the years.

BENTLEY GLASS

GENERAL BIOLOGY. *Third Edition.*

By James Watt Mavor. The Macmillan Company, New York. \$5.50. xiv + 986 pp.; text ill. 1947. The revision of this widely used textbook (cf. Q. R. B. 16: 482. 1941) brings its total number of pages to almost a round thousand. The changes made appear to have been largely matters of rearrangement. For example, Part V has now been subdivided into two parts, one on Development and Heredity, the other on The Organic World and Its Evolution. To the latter there has been added a 58-page chapter on Animals and Plants in Relation to their Environment, which excellently fills in the ecological hiatus of earlier editions. The chapter on The Mechanism of Organic Evolution has been much expanded, and now includes a consideration of population genetics altogether novel in an elementary college textbook.

The new edition is not printed on paper of as good a quality as was formerly used, and the quality of the illustrations has as a consequence suffered materially.

BENTLEY GLASS

LABORATORY EXERCISES IN GENERAL BIOLOGY. *Third Edition.*

By James Watt Mavor. The Macmillan Company, New York. \$3.00 (paper). xiv + 333 pp. + 3 plates; text ill. 1947.

The revision of this widely used laboratory manual introduces little, if any, fundamental change. There is an added exercise on a Simple Plant (*Spirogyra*) and a Simple Animal (*Hydra*) at the beginning of the course; a more detailed study of the cell, particularly of cell physiology, and of bacteria; an added study of the life cycle of *Selaginella*; a unit on the Parasites of the Frog; and a short exercise on the sagittal section of the dogfish. There has been some rearrangement of the exercises, and sample schedules for year courses with a single and with two laboratory periods per week are provided.

LIFE SCIENCE: A Survey of the Various Fields of Biology. *Third Edition.*

By M. W. de Laubenfels. Prentice-Hall, New York. \$4.75. iv + 340 pp.; ill. 1946.

This unusual book now appears in its third edition. Although the reviewer has not had the benefit of examining previous editions, it is to be assumed from the Preface that the third is similar to the second revised edition.

The adjective "unusual" was purposely selected, as it best describes the variance of the present book with the majority of orthodox textbooks in the field. No other book attempts to cover the wide range of scientific knowledge that this does. Selected at random, chapter headings include biophysics, hygiene, dietetics, oceanog-

raphy, eugenics, and philosophy. This varied assortment is apportioned to 26 chapters (A to Z, instead of 1 to 26) which follow one another in a rather logical sequence. The chapters are grouped into eight parts, of three or four chapters each, containing closely related subject matter.

The first impression obtained from such a table of contents is that the text will be rather vague and superficial. It is true that no topic is probed deeply, but the writer maintains that a beginning student should first have a survey of life sciences and that specialization follows. The humorous, and at times dramatic, method of presentation, interlarded here and there with useful practical examples by way of analogy, make this a highly readable volume. A few statements were noted that are at variance with the facts, but as a whole the presentation is as accurate as an elementary textbook can be. By including such a varied array of sciences the writer should indeed accomplish one purpose: to impress the student with the fact that no discipline is independent of any other. Anyone who desires to change the standard methods of presenting beginning biology should become familiar with this publication. It affords many interesting ideas that break away from the clichés found in so many biology books. Even the numerous drawings and photographs are highly original.

HENRI C. SEIBERT

LIVING THINGS: How to Know Them. *An illustrated key to the phyla, classes and more important orders of Plants and Animals with suggestions for studying them. Pictured-Key Nature Series. Revised Edition.*

By H. E. Jaques. Wm. C. Brown Company, Dubuque, Iowa. \$2.50 (cloth); \$1.50 (spiral). iv + 172 pp.; ill. 1946.

This little book is a picture key to the phyla, classes, and more important orders of plants and animals. Although its greatest popularity will be for beginners in nature study, who will probably not appreciate the foreign words by which animals and plants are recognized, it is nevertheless unfortunate that so many scientific names have been misspelled. A cursory examination revealed "Cestus" and "Cestis" for *Cestum*; "Ancylostoma" for *Ancylostoma*; "Libelula" for *Libellula*; "Phylophaga" for *Phyllophaga*; "Polydon" for *Polyodon*; "catesbiana" for *catesbeiana*; "Eranaceus" for *Erinaceus*; "Ceryte" for *Ceryle*; "flaxiventris" for *flaxiventris*; "Amydia" for *Amyda*; "Pycnogonida" for *Pycnogonida*, etc.

Elementary biology teachers who find themselves required to identify all manner of organisms may find this an useful aid. It is not restricted in geographic scope, hence many exotic species are included that are likely to be seen at the zoo. There are 117 suggestions for projects to stimulate interest in nature study.

HENRI C. SEIBERT

BASIC PRINCIPLES OF GENERAL BIOLOGY. (*A laboratory with synoptic text material.*)

By Clair L. Worley. Wm. C. Brown Company, Dubuque, Iowa. \$3.00 (unbound; perforated for notebook). vi + 269 pp.; ill. 1946.

The chief characteristic of this laboratory guide, which has a modicum of introductory text accompanying each exercise, is that it really is confined to general principles, that is, to certain general principles. The consideration of plants is limited to the thallophytes and that of animals goes no higher in the scale than the coelenterates. Such a manual will therefore be suitable only where the introductory course in biology can be followed by courses in both general botany and general zoology. The manual is neat in appearance, and the drawings are attractive. Mitosis, however, is all tangled up with spindles; and meiosis is presented from a diagrammatic, "reduction division followed by equation division" point of view. The cell and cellular physiology are emphasized, but genetics, embryology, and evolution are apparently not considered by Worley to have any contribution to make to the "basic principles of general biology." This narrow basis for the selection of subject matter will not recommend the manual to many teachers of biology.

BENTLEY GLASS



EVERYDAY PROBLEMS IN SCIENCE. *Basic Studies in Science. Second Edition.*

By Wilbur L. Beauchamp, John C. Mayfield and Joe Young West. Scott, Foresman and Company, Chicago, Atlanta, Dallas, New York. \$2.40. xvi + 752 pp.; ill. 1946.

This revised general science textbook for high school students has 20 units, of which only 5 are biological in subject matter. These deal with: the common characteristics of living things; food and nutrition; human anatomy, physiology, and hygiene (but with nothing on sex or reproduction); germs and disease; and conservation. The illustrations are interesting, but the half-tones are not very clear. The diagrams and drawings are good. The style of the text is interesting and simple. The introductory section on the methods of science is very good, without departing from the level of the remainder of the book. Experiments and problems to solve, and lists of supplementary reading are suggested, section by section. A science glossary and a full index conclude the book.

This is a good example of the present type of general science textbook used in the United States. Its nature raises several questions: if the student is going on to take biology in the following year, as so many do, wouldn't it be better to devote all 20 units to the physical sciences? If this is all the science study the student will have in high school, what an appallingly meagre

introduction to biology! Most science books for the younger grades cover the same topics in almost an identical way.

BENTLEY GLASS



BIOLOGY: HISTORY AND BIOGRAPHY

THE MEDICAL WRITINGS OF ANONYMUS LONDINENSIS.

By W. H. S. Jones. Cambridge University Press, Cambridge. \$2.75. viii + 168 pp. 1947.

This is the expert transcription and translation of a Greek papyrus, probably of the second century A.D. The contents are a discussion of the causes of disease according to various authorities of antiquity, and of physiological theories after Herophilus of Alexandria. The fragmentary and careless character of the book suggests that we are dealing with a student's notebook. Parts of it might be based on the writings of Menon, a pupil of Aristotle. The papyrus offers interesting additional information on the history of Greek medicine to the specialist, but is unlikely to be attractive to the average scientist interested in the history of medicine.

ERWIN H. ACKERKNECHT



ANDRÉ VÉSALÉ. *Collection Nationale, 1^{re} Série, No. 7. Second Edition.*

By Georges Leboucq. Office de Publicité, J. Lebègue & Cie., Bruxelles. 25 fr. (paper). 101 pp. + 1 plate. 1944.

This brochure, written in French by a Belgian anatomist, was apparently timed for the four-hundredth anniversary of the publication of *De Humani Corporis Fabrica Libri Septem*. It is a largely second-hand account of the life and influence of the founder of human anatomy. There are six chapters, dealing, respectively, with (1) the fore-runners of Vesalius, (2) Vesalius as an anatomist, (3) as a physician, and (4) as a man, (5) anatomy from Vesalius to Harvey, and (6) the physiology of Vesalius. The last chapter, written by the Belgian physiologist De Waele, consists chiefly of a translation of book VII, chapter XIX, of the *Fabrica*:—Some Considerations on the Dissection of Living Beings.

WILLIAM L. STRAUS, JR.



JEROME CARDAN. *Supplements to the Bulletin of the History of Medicine, Number 7.*

By James Eckman. The Johns Hopkins Press, Baltimore. \$2.00; for subscribers to the *Bulletin of the History of Medicine*, \$1.75 (paper). xiv + 120 pp. 1946.

This short monograph, which takes the form of a re-evaluation of the life and works of Jerome Cardan, is a

well-written and painstaking study of the enigmatic Italian sixteenth century mathematician and scientist.

Its primary virtues are its accuracy, thoroughness, and objectivity. Cardan is familiar as the inventor of the universal joint which still bears his name, notorious as the astrologer who cast the horoscope of Christ, infamous as the publisher in his own works of Tartaglia's method for the solution of cubic equations. Sir Thomas Browne has said of him that he was "a great enquirer of truth, but too greedy a receiver of it." Eckman has assessed the wealth of available fact and fiction concerning him, has emphasized his less recognized contributions to medicine, and has succeeded in presenting fairly and weighing judiciously the evidence on controversial issues according to the best precepts of cautious and exhaustive scholarship.

Its very strength, in this respect, is responsible for the study's greatest weakness. This is an elusive fault to define or describe. It is perhaps a kind of bookishness—something different than straight pedantry. It may best be illustrated by a few examples. Its defensive attitude towards the University of Padua, for instance, of which Cardan was Rector, implies that posterity has failed to recognize the contributions of that institution to the Renaissance. Perhaps no one has ever written a monograph for the sole and express purpose of extolling the position in history of that university, but there are few if any historians of Renaissance medical science who have not fully appreciated its preeminence. The author's explicit statement, and its justification by references to secondary sources (excluding Haskins, by the way), that "it is now recognized that there had been other . . . periods of renaissance before the Renaissance" is gratuitous today, and a little naive. Again, Eckman's resentment of the fact that in 1945, "the quarter-centenary of the publication of Cardan's *Ars Magna* . . . Cardan was in no wise accorded the tributes paid to Vesalius and Copernicus in 1943," is wholly academic. Misjudged though he may have been by posterity, and even Eckman can convince us of no more than this, Cardan's contributions in no way exerted the kind or magnitude of influence on the fabric of contemporary ideas nor on the evolution of subsequent ones of either the *De Fabrica* or the *De Revolutionibus*.

The author might well have done better to devote some energy to pointing out that the kind of contemporary sixteenth century rumor which could lead to the myth that Cardan bit off the ear of his son, smacking to us of scandal-mongering, was abundant in sixteenth century biography; and that de Thou, for instance, has been shown by posterity to have been as sensationalist in relating anecdotes about other sixteenth century scientists. There are subtler ways of relating a man to his contemporaries than by the bare enumeration of the names of the men who were alive in his day.

What I mean to imply is that while Eckman's facts about the era in which Cardan lived are accurate, they do not give the "feel" of the times to the reader. So

too for the man himself. It may sound paradoxical, but for one reader at least it is apt to comment that Eckman suggests that Cardan must be a more interesting figure than he *shows* him to be; he never comes quite alive. It is as though Eckman had a greater interest in the writings about Cardan and his times than in the man himself and the Renaissance itself. What lacks is the author's sense of identification of himself with the man who is his subject and with the thought characteristic of his age—an identification which is the vitalizing ingredient of the most vigorous of our retrospective studies. That accuracy and carefulness and dispassionateness need not be sacrificed to such indulgence of the imagination is well proved by Sherrington's analysis of *The Endeavour of Jean Fernel*.

These remarks are in no wise meant to detract from the considerable contribution of the author in applying the most critical methods of historical research to the production of a work of this sort. Students of the history of medicine in the past have too often failed to apply in their historical ventures the same kind of critical thinking that they devote to what they consider their more strictly scientific endeavours. This monograph happily indicates that this is a phase which we are leaving behind us. We are urgently in need of much more of the same sort of evidence. Eckman's study of *Jerome Cardan* is on the whole a monograph well worthy of inclusion in the distinguished series of supplements sponsored by the *Bulletin of the History of Medicine*.

Commendable is the enlightened practice of the editors in allowing quotations to be presented in the language in which they were written (only why, then, the anglicisation of *Jerome*?). The bibliography would, however, be more useful if the entries were arranged in some more meaningful order than the sequence in which the works cited happened first to be mentioned in the text.

JANE OPPENHEIMER



J.-B. VAN HELMONT. *Collection Nationale, 7th Series.* By Henri De Waele. Office de Publicité, S. C., Bruxelles. 25 fr. (paper). 79 pp. + 1 plate. 1947. This is a competent, short review of the life and work of the great 17th century Belgian medical chemist. Particular attention is given to the Inquisition trial of van Helmont, pending for sixteen years. Good use is made of the numerous Belgian source studies of the last hundred years. Van Helmont's Flemish book *Dageraad* (not the customary *Ortus*) is mostly used for documentation of his scientific views. Although the author has little use for van Helmont's mysticism, he is sufficiently impressed by his positive accomplishments to give him due to the pious Belgian nobleman who was one of the great scientific reformers and pioneers of the 17th century.

ERWIN H. ACKERKNECHT

400 YEARS OF A DOCTOR'S LIFE.

Collected and arranged by George Rosen and Beate Caspari-Rosen. Henry Schuman, New York. \$5.00. xviii + 429 pp. 1947.

From selections out of about one hundred medical autobiographies, mostly 19th century products, but incorporating also older worthies like Paré, Paracelsus, Felix Platter, or Cardanus, the authors have constructed a kind of mosaic portrait of the Doctor, his youth, student days, daily practice, and scientific endeavors. The doctor is also shown as a marriage candidate, a patient, in war and in politics. Those who like anthologies will find here a most sensitive and stimulating selection, moving and enlightening at the same time. The authors master their subject matter. There is a fine balance between the "classics" of medical autobiography and less known sources, between European and American material, between older and more recent pieces, between men and women. The external appearance of the book, the translations, and the short introductory notes are excellent.

ERWIN H. ACKERKNECHT



THE WORLD GROWS ROUND MY DOOR: *The Story of the Kampong, a Home on the Edge of the Tropics.*

By David Fairchild. Charles Scribner's Sons, New York and London. \$5.00. xiv + 347 pp.; ill. 1947. An appropriate subtitle for this book might be "The Fruits of My Labor," for in a literal, as well as in a figurative sense, this story of the Kampong, Fairchild's home at the edge of the Florida tropics, is one largely concerned with the joys and surprises, the disappointments and even tragedies that arise out of the introduction and cultivation of the many tropical and exotic fruits which he, as plant explorer extraordinary, had uncovered in his travels around the world. It is an intimate book, revealing a warm and varied personality who has found life to be as flavorful and full-bodied as one of the mango fruits he never ceases to delight in describing. It is a readable book, full of reminiscences and personalities, both plant and man. And it is a proud book, as well as it might be, for David Fairchild can truly be said to have richly harvested the fruits of his labors.

One need not be a botanist to enjoy the many hours of reading pleasure which this book affords, for Fairchild has the rare faculty of making his readers share his experiences. The numerous photographs add to the book, giving form to the fruits with which he has worked, and the men—Swingle, Merrill, Popenoe, and Tom Barbour, to name a few—with whom he has been associated. A single minor criticism might be made, and that concerns the undertone of querulous impatience Fairchild shows for those who cannot appreciate and share his points of view. Although under-

standable, it does not permit the enjoyment of the book to its fullest.

C. P. SWANSON



THE ROYAL BOTANICAL EXPEDITION TO NEW SPAIN 1788-1820 as described in documents in the *Archivo General de la Nación [Mexico]. Chronica Botanica, Volume 11, Number 1.*

Translated and collated by Harold William Rickett. The Chronica Botanica Company, Waltham, Massachusetts; Stechert-Hafner, New York. \$2.50 (paper). Pp. 1-86 + 9 plates; text ill. 1947.

From the national archives of Mexico, Rickett has extracted and described chronologically the work of the botanical expedition sent in 1787 by Charles III of Spain to survey his domain of New Spain (Mexico) for natural products, and to establish a botanical garden. The result is a volume which should be of much interest to the student of Latin America as well as to the student of botanical history, for, in addition to information of a purely botanical nature, it contains much concerning the political and social conditions of that period of Mexico's struggle as a Spanish colony.

C. P. SWANSON



V. O. KOVALEVSKY. *Series of Popular Science: Biographies.*

By L. Sh. Davitashvili. The Academy of Sciences of the USSR, Moscow and Leningrad. R. 20.- 420 pp. + 8 plates. 1946.

This is the second biographic book on Vladimir Onufrievich Kovalevsky, the first one having been written twenty years ago by the late academician Borissiak. The author of the new book is one of the ablest among the post-revolutionary Soviet paleontologists. Prudently announcing his intention to write truth and nothing but the truth about the man who is becoming recognized as the greatest among Russian paleontologists, perhaps even among philosophical paleontologists of the world—Davitashvili proceeds to unfold systematically Kovalevsky's life's drama—and what a drama it was, leading to a tragic end of a noble, though strangely unadaptable, "out of this world" soul! With the skill of a psychologist the author analyses the development of the great man's personality, shows how his scientific ideas were born, how he created a new analytical approach to solve the problems of evolution of fossil organisms, an entirely new and powerful philosophical method, which even now has not been completely understood and mastered by his successors. The author sketches, as he goes, also the contemporary epic struggle, in which Kovalevsky took a prominent part: that clash between old and new ideas as to the origin of organisms, the "Sturm und Drang" period of revolu-

tionary Darwinism. Kovalevsky's correspondence and personal pilgrimages to the great man of Down, his decision to devote his life to his cause, and his consistency in the execution of the great self-imposed task, are narrated by Davitashvili in a manner both compelling and literary, holding the reader's attention even through the pages of scientifically most difficult explanations of Kovalevsky's contributions to our knowledge of the intricate, step-by-step evolution of horses and other selected herbivores.

The book will easily find a place among classic biographies of scientists, as an example of how to write an impartial, documentary account of a man's life and relationships with other human beings, yet making it so interesting, and at times even breath-taking reading. Kovalevsky stands before us in flesh and blood, with all his virtues and faults. His devotion to his wife and selected friends does not prevent him from hurting them occasionally and inadvertently. His puritanism, honesty, and kindness do not shield him from vicious slander. His capable and hard work in translating and publishing classics in the natural sciences brings him only a modest income, he becomes involved in financial follies, and ends his life when faced with bankruptcy and inability to provide for his wife.

Kovalevsky's zeal and genius in scientific achievements slowly gained for him recognition and fame among the foremost scientists of his time, but his temperamental impatience with mediocre colleagues, who did not understand him, resulted in making him bitter and vindictive enemies. The general pattern of the drama is the same for many men of talent and distinction, repeated through the history of mankind.

A specialist in the evolution of vertebrates will find some professionally interesting and useful information on Kovalevsky's accomplishments and his method of work, that method hailed by Osborn as classical in paleontology. Davitashvili has done a good job in extracting from Kovalevsky's monographs the most instructive examples of the paleontological material on which his method was based and tested, and has republished appropriately selected original illustrations.

Appended are (1) a bibliography of Kovalevsky's original contributions; (2) a list of the scientific books translated, edited, and published by him; and (3) the literature cited in the present biography. The book is attractively published, on good durable paper, with a few portraits of Kovalevsky and facsimiles of his letters and pen sketches; but reproduction of the photographs is poor, and so is the material of the cloth cover, although its workmanship is neat and the cover is artistically attractive.

M. K. ELIAS



ECOLOGY AND NATURAL HISTORY

THE LAND AND WILDLIFE.

By Edward H. Graham. Oxford University Press,

New York. \$3.00. xiv + 232 pp. + 32 plates. 1947.

The main thesis developed in this book is that the fate of wildlife ultimately rests on the fate of the land. The most beneficial utilization of land to man involves careful husbandry and thoughtful exploitation of its potentialities. When this fact is appreciated and acted upon, the wildlife will take care of itself. Wildlife will not survive in overworked, overgrazed, eroded, polluted, burnt, and otherwise damaged areas. Those species that occasionally invade areas of such type are in general undesirable ones, as ground squirrels and prairie dogs in overtaxed grasslands. No matter how many refuges are created, pen-reared animals released, or laws and regulations passed, the productivity of wildlife will not be materially increased thereby. Success will be achieved only by converting all available farms into potential wildlife refuges by promoting an interest in the proper methods of soil conservation. This includes the creation of field borders, hedges, and windbreaks around crop lands; roadside and streamside plantings; plantings in gullies and other eroded areas; proper care of woodlots, forests, marshes, and ponds. If these procedures are adopted, not only will the land benefit, and of course the owner too, but the wildlife will increase and maintain itself because of these very same practices.

The arguments presented here follow the newer concepts now being adopted in isolated instances in the field of wildlife management. The tendency is toward closer cooperation between the individual land owner and the various administrative agencies which are concerned with land management. Marked success has followed most of these ventures. However, there are still a number of drawbacks. For some wildlife, such as migratory game, the problem is not easily solved on the basis of land use alone. But for a long term, overall objective, the data and conclusions propounded in this book are hardly assailable. It is encouraging to learn that the Chief of the Biological Division of the U.S. Soil Conservation Service has brought forth a logical, unbiased, and practical scheme for conserving our national fauna.

Methods of managing field borders, woodlots, hedges, strip-mined areas, erosions, outcrops, range, pasture, streams, ponds, etc., for the betterment of wildlife are discussed. There is a bibliography, an index, and numerous plates that vividly show the improvements resulting from wise land use. Figures and tables supply much factual information.

HENRI C. SEIBERT



ANYWHERE IN THE WORLD: The Story of Plant and Animal Adaptation.

By Irma E. Webber. William R. Scott, New York. \$1.50. 64 pp.; ill. 1947.

A children's book on the geographic distribution and adaptations of plants and animals, showing how various

environmental problems are dealt with. The book is profusely illustrated with colored drawings, has an interesting narration, and should prove attractive to children.



EVOLUTION

CAMBRIAN HISTORY OF THE GRAND CANYON. *Part I. Stratigraphy and Ecology of the Grand Canyon Cambrian. Part II. Cambrian Fossils of the Grand Canyon.* Carnegie Institution of Washington Publication 563.

By Edwin D. McKee (I) and Charles E. Resser (II). Carnegie Institution of Washington, Washington, D. C. \$3.00 (cloth); \$2.50 (paper). viii + 232 pp. + 27 plates. 1945.

The Grand Canyon area has always had a special scientific fascination for students of all branches of the geological and biological sciences. To the geologist the opportunities for tracing the rock units for long distances along the walls of the canyon has afforded unrivalled demonstrations of basic principles of stratigraphic geology. The first parties to explore the entire canyon from end to end by boat were led by a geologist, Major John Wesley Powell, in 1869 and 1871. (Powell later became the founder and first director of the United States Geological Survey.) A multitude of other geologists have followed Powell in studying the rock sequence here, but no one has had the opportunities that were afforded E. D. McKee during the several years that he served as Chief Naturalist at the Grand Canyon National Park. The present volume is but the latest of the series of detailed stratigraphic studies that have resulted. It maintains the high standards that were built up by its predecessors.

McKee shows that the Cambrian deposits of the Grand Canyon include numerous widespread fossil beds, thin but persistent conglomerate zones, and other horizons of distinctive lithology. These have been traced in the practically continuous exposures of the canyon walls and their relationships to each other have been examined in detail. Study was made of the relation of time planes to lithogenetic units, and also of the association and sequence of facies within definite time zones.

With this information it has been possible to demonstrate that the lower Cambrian sea advanced across the area, from west to east, as a result of discontinuous subsidence of the basin that existed in the area. When the sinking of the basin was relatively rapid, the sea transgressed it rapidly; when the rate of subsidence was slow, or the basin was static, the accumulation of deposits within it forced the sea to withdraw. During each period of marine transgression, the same general sequence of deposits was developed from the open sea to the shore; during periods of regression a different sequence was deposited. The result is a clear picture of the manner in which lithologic facies cut across time

lines. During any one period of transgression, for example, the shoreline facies to the west would be older than the strata of the same facies in its easternmost development formed at the time of maximum transgression. Thus it is possible for McKee to prove that the Tapetts sandstone, the basal Cambrian formation of the Grand Canyon sequence, is of lower Cambrian age near the western end of the canyon, and lower Middle Cambrian age near the mouth of the Little Colorado River.

The faunal descriptions by Resser form the first relatively complete picture of the Cambrian fauna of that area, and are based on a large number of collections made over the years by members of the U.S. Geological Survey, the U.S. National Museum, and members of the Grand Canyon National Park naturalists staff. Perhaps the most noteworthy element of the fauna is a species of cystoid, described by Edwin Kirk, from two relatively complete crowns, with arms, found near the base of the Middle Cambrian sequence in the Bright Angel shale. Trilobites and lingulellid brachiopods dominate the fauna, although a number of species of ostracods also occur.

H. E. VOKES



REVISION OF THE UPPER CAMBRIAN FAUNAS OF NEW JERSEY. *Geological Society of America Memoir 12.*

By B. F. Howell. *Geological Society of America, New York.* 85 cents (paper). 46 pp.; 8 plates. 1945.

The upper Cambrian deposits of New Jersey consist of dolomitic limestones that are often sandy or shaly, and locally grade laterally into lenticular shales and sandstones. Mud cracks and ripple marks are common and indicate that most, if not all, of the beds are of shallow water deposition. These strata have been referred to the Kittatinny formation.

In view of the type of lithology and of the apparent depositional facies represented, it is not surprising that fossils are rare and, when found, poorly preserved. Howell has gathered together all the previously described forms (15 species) and has added the material that he has collected over many years of investigations in the area. The result is a fauna of 50 forms, of which 34 are trilobites, 11 brachiopods, 2 hyolithids (believed by the author to be worms rather than pteropods), 1 conchostracoon, 1 graptolite, and 1 calcareous alga. Three new genera of trilobites are described. All of the fossils come from four general localities.

Two upper Cambrian horizons are recognized, one is early upper Cambrian (Dresbachian), the other late upper Cambrian (Trempealeauian) in age. Howell notes that no evidence has been found for the existence of medial upper Cambrian (Franconian) strata in New Jersey, and is inclined to believe that there is a sedimentary break within the Kittatinny. No stratigraphic evidence of such a hiatus has, however, been discovered.

The full-tone plates reflect the poor preservation and

fragmentary nature of the material that the author has had to deal with.

H. E. VOKES



BRACHIOPODA OF THE INDEPENDENCE SHALE OF IOWA.
Memoir 14.

By Merrill A. Stainbrook. *The Geological Society of America, New York.* \$1.00. vi + 74 pp.; 6 plates. 1945.

Forty species of the Brachiopoda are described from the upper Devonian Independence shale of Iowa; 27 are new species. They are placed in 35 genera, 7 of which are diagnosed here as new. These are *Douwillinaria* and *Pseudodouwillina* (Stropheodontidae, Douwillininae) *Gamphalosia* (Stropheodontidae, Leptostrophiinae) *Calvinaria* (Camarotoechiidae, Leiorhynchinae), *Hystericina* (Atrypidae, Atrypinae), *Acutatheca* (Spiriferidae Spiriferinae), *Thomasaria* (Spiriferidae, Ambocoeliinae).

The fauna is considered to be the American equivalent to the lower Upper Devonian "Cuboides fauna" of Europe. Its American correlatives are discussed in detail. The descriptions are full and the illustrations of excellent quality.

H. E. VOKES



ANCIENT PLANTS and the World They Lived in.

By Henry N. Andrews, Jr., with drawings by Anna Schutte. *Comstock Publishing Company, Ithaca, New York.* \$4.50. xii + 279 pp.; ill. 1947.

It has been several years since Knowlton's *Plants of the Past* first appeared, and it has long been out of print, leaving us with no popularly written, yet authoritative account of the fossil plant record. The present volume fills this gap in very acceptable fashion, so far as the more ancient and more primitive plants are concerned. The absence of anything beyond a brief mention of the great groups of angiosperms is puzzling and leaves the work notably incomplete.

The book consists, essentially, of a number of essays, each relatively complete in itself, and each not necessarily having any particular relationship to that which precedes or follows it. At times the order of presentation seems wholly a haphazard one. According to the author, he has "tried to introduce first the plant groups with which the lay reader is already familiar, and to tell something of our knowledge and our methods of seeking out their geological history." Even this seems inadequate to explain the fact that Chapter 3, *Lingering Remnants of the Coal Age*, precedes Chapter 5, *Coal, Fuel from Yesterday's Forests*, and is separated from it by a discussion of the *Invasion of the Land*, concerned with the Silurian and Devonian types of most primitive land plants. Similarly the sequence of the last five chapters (*Changing Climates of the Pacific Coast*; *The*

Algae, Fungi, and Mosses; *The Fossil Hunters*; *Past Epochs of the Arctic*; *Genealogies in the Plant Kingdom*) seems explicable on no basis save that of whim.

Despite this seeming confusion, and even despite the absence of any approach to an adequate consideration of the angiosperms, this is a good and a needed work that will well merit reading by anyone who desires to have some knowledge of the history of the fossil plant record.

H. E. VOKES



MANUEL DE PALÉONTOLOGIE VÉGÉTALE.

By Léon Moret. *Masson et Cie., Paris.* 250 fr. (paper). viii + 216 pp.; ill. 1943.

This work, as indicated by the title, is a manual whose major portion is devoted to a consideration of the important plant groups, arranged in a strictly biological order. The general nature of the work is perhaps best indicated by a consideration of the general table of contents. Following a short introductory chapter on the importance of the science of Paleobotany, the methods of fossilization of plant remains, the origin of the "monde végétal," and the main stages in the evolution of the plants, the work is divided into five parts, as follows:

Part 1. Thallophytes: the Bacteria, Flagellates, Algae, Fungi and Lichens, and Charophytes.

Part 2. Bryophytes.

Part 3. Pteridophytes: the Psilophytales, Lycopodiales, Equisetales, Filicales, and the Cladoxylales.

Part 4. Spermatophytes: the Gymnosperms (including the Pteridosperms, Cordaitales, Cycadales, Bennettitales, Ginkgoales, Coniferales, Gnetales and Caytoniales), and the Angiosperms.

Part 5. General Conclusions: this includes a most interesting series of chapters discussing such topics as the "transformations" of the plant world, the role of plants in the formation of rocks, and the carbonaceous rocks and the formation of coal.

The work is copiously illustrated, most of the figures including a number of line drawings of vegetative or reproductive characters important in the identification of various plant types. They are an important adjunct to a valuable and useful manual of the fossil plants.

H. E. VOKES



PERMIAN FUSULINIDS OF CALIFORNIA. *Geological Society of America Memoir 17.*

By M. L. Thompson, Harry E. Wheeler, and John C. Hazard. *The Geological Society of America, New York.* \$1.25. viii + 77 pp. + 18 plates. 1946.

This work is divided into three parts. Part I includes a most valuable summary of the more important Per-

mian fusulinid faunas of North and Central America. Four fusulinid zones are recognized, and the ranges of all the genera known to be present in the faunas are indicated. In addition, a summary of the classification and generic characters of all the genera found in the California faunas is presented here.

Part II, by M. L. Thompson and Harry E. Wheeler, describes the faunas from the McCloud limestone and Nosoni formation of the Redding area of northern California. Thirteen species are recognized, including two that are referred to the genus *Neofusulinella*, a form that otherwise is known only from the Orient.

Part III, by M. L. Thompson and John C. Hazzard, describes faunas obtained from the Bird Spring limestone in the Providence Mountains of San Bernardino County, southern California. Fourteen forms are recognized, only one of which is also found in the McCloud fauna from northern California.

H. E. VOKES



CONTRIBUTIONS TO THE PALEONTOLOGY OF THE LEBANON MOUNTAINS, REPUBLIC OF LEBANON. Part 3. *The Pelecypod Fauna of the "Olive Locality" (Aptian) at Abeih. Bulletin of the American Museum of Natural History, Volume 87, Article 3.*

By Harold E. Vokes. American Museum of Natural History, New York. \$1.25 (paper). Pp. 139-216; text ill. + 10 plates. 1946.

In the course of the decade since Vokes started his research on post-Paleozoic marine pelecypods, he has reached maturity of judgment, which places him among the leading contemporary specialists in this group of fossils. His present contribution to the knowledge of Cretaceous bivalves is not only useful for the geology of the Near East, but is also philosophically important for the disentanglement of the complex phyletic relationships and evolution of these mollusks.

The selection for research of Lebanon fossil bivalves is fully justified by the unusually fine preservation of their details, particularly those pertaining to the hinge, on which the current recognition of genera of these mollusks is universally based. Thanks to the superior preservation of the material, Vokes has been able to erect many new fossil genera: out of forty genera described, eight are new (including one by Stephenson, and cited with a permission from his MS); it may be added that among the identified and previously established 32 genera three were recently (1944, 1945) erected on the same material by Vokes. Of the 58 species described 24, or nearly two-fifths, are new.

The description of genera and species shows a careful comparison with the previously described fossil and living pelecypods of the world, some types having been examined in European museums. A brief chapter on ecology is comprehensive, and the conclusion that the fauna does not belong to the zone of tides, but is next

deeper to it, yet not deeper than 50 fathoms, seems well substantiated.

The illustrations (collotype reproduced photographs), though mostly satisfactory, in many instances look flat, with the details of sculpture barely discernible. Standardized illumination from the left upper corner, with greater contrast in negatives and prints, and a regular arrangement of sets of front, back, top, and side views for each species could be recommended.

The large per cent of new genera (11 out of 40) established on the evidence of good preservation of generic characters is an important evidence of the actual existence of much greater numbers of fossil pelecypod genera than are registered in the present manuals of paleontology, and which have been recently used statistically to prove a supposed slower evolution of mollusks as compared with Tertiary vertebrates (G. G. Simpson, *Tempo and Mode in Evolution*, 1944). The existence of a substantially larger number of late Paleozoic genera of pelecypods than are entered in the manuals, and the evidence of about as fast an evolution of the genera of Triassic ammonites (see J. P. Smith, 1927, 1932, and not entered in H. H. Swinnerton's *Outline of Paleontology*, which Simpson used), have been already mentioned in the reviewer's paper read at the first annual meeting of the Society for the Study of Evolution (December 1947). The data by Vokes provide additional evidence that the current statistics of the fossil mollusk genera should be substantially revised.

M. K. ELIAS



Eocene Faunas from the Department of Bolivar, Colombia. *The Geological Society of America Memoir 16.*

By Bruce L. Clark and J. Wyatt Durham. *The Geological Society of America, New York.* \$1.75. vi + 126 pp.; 27 plates; 1 map. 1946.

This work consists of two parts: a description of the molluscan faunas, by Clark, and of the coral faunas, by Durham. The material studied was largely furnished by the Standard Oil Company of California, having been collected by their field geologists during the investigations of the El Carmen district of the Department of Bolivar. While the company furnished the authors with a copy of the geologic map for their use during the course of the study, they did not release it for publication, nor did they permit the use of the reports of their geologists on the district. As a result, although it was possible for the authors to place the collections in their correct stratigraphic position, the stratigraphic data that would have added much to the value of this report are lacking.

On the basis of the Mollusca, Clark divides the fauna into three zones (A, B, and C). The fauna of Zone A contains species closely related to some from the middle Eocene of Peru, and in addition, two forms that were

originally described from the middle Eocene of California. Zone B has several species identical with, and some that are closely related to the fauna of the Talara formation of Peru, described by Olsson. Olsson correlated the Talara with the lower Jackson, of the southeastern United States and with the Bartonian of Europe; Clark concurs in assigning an early upper Eocene age to the assemblage. The fauna of Zone C is the largest and best preserved. It contains species described by Olsson from the Saman formation and the Chira shales of Peru. Olsson considered that these were of uppermost Eocene and lower Oligocene age, respectively. In addition, the fauna of Zone C contains several species that otherwise occur in the upper Eocene Jackson formation of the southern United States. Clark believes that the fauna of this zone is of upper Jacksonian age, and that both the Saman and Chira shale faunas should also be referred to this horizon.

Notable among all of these faunas are a number of elements that make their first appearance here and have not been found in any other Eocene provincial fauna. Many of these elements later become of world-wide distribution, and some are still living. Clark concludes that these western South American Eocene faunas were rather isolated, particularly in pre-Zone C time, and that evolution was taking place independently within the area. Even when it was possible for the Jackson faunal elements to migrate into the area, there was no concurrent migration from the Colombian region northward into the Gulf Coastal zone. The large number of new genera and subgenera described (5 genera and 3 subgenera of gastropods, and 3 genera of pelecypods) reflects the indigenous character of the fauna.

Nine species of corals are described by Durham. Eight are from deposits containing the Zone C molluscan fauna, one is from Zone B. Four are shallow water reef-forming colonial types, the others are solitary forms.

H. E. VOKES



MOLLUSCA OF THE TERTIARY FORMATIONS OF NORTHEASTERN MEXICO. *Memoir 11.*

By Julia Gardner. *The Geological Society of America, New York.* \$3.25 (paper). xi + 332 pp.; 28 plates. 1945.

The Tertiary molluscan faunas of the Coastal Plain area of the United States have been well known for many years, and those of the Tampico embayment of Mexico have also received much study. The intervening area, the coastal plains of northeastern Mexico, have been generally neglected. Recent petroleum investigations within this region, however, have resulted in rather extensive collections of fossil invertebrates. These were submitted to Julia Gardner by the companies concerned, and the results of her studies have been gathered into this comprehensive report. Collec-

tions from more than 400 separate localities were studied in its preparation.

Introductory to the systematic descriptions is an excellent summary of the stratigraphic section exposed in the area. It reveals the presence of a relatively complete, and fossiliferous section ranging from Paleocene to middle Miocene in age, with only one gap, there being no equivalents of the upper Wilcox, Hatchetigbee formation. In general, the formations are but a continuation of those exposed in the South Texas coastal plain area and Texan stratigraphic names have been applied to the Paleocene and Eocene formations. The Mexican Oligocene and lower Miocene sections are more complete than those of the South Texas region.

The systematic paleontology includes the description or discussion of 83 species of pelecypods, with 89 other forms recognized as being present, but too poorly preserved for description or certain identification. The gastropods include 125 species, plus 75 others that are too poorly preserved for recognition; 3 cephalopods, 5 scaphopods, 1 "Chaetopoda," and 1 insect are also recognized. Three new genera, 2 new subgenera, and 2 new sections are described.

In stratigraphic arrangement, the Paleocene fauna includes 28 species, with 15 others too poorly preserved for certain identification; the lower Eocene, 17 and 12 species in these respective categories; the middle Eocene, 104 and 59; upper Eocene, 28 and 22; the Oligocene, 44 and 35; and the lower and middle Miocene, 11 and 22 species in these respective categories.

The full-tone plates are excellent, and with the full descriptions and stratigraphic notes combine to make the work a notable milepost in our knowledge of the geology of the land south of the Rio Grande.

H. E. VOKES



EVOLUTION OF THE HORSE BRAIN. *The Geological Society of America, Memoir 25.*

By Tilly Edinger. *The Geological Society of America, New York.* \$2.00. x + 177 pp. + 4 plates; text ill. 1948.

The evolution of the brain, particularly of the mammalian brain, is a subject of manifest and peculiar importance. No problem of evolutionary morphology commands greater interest, and none is likely to have wider ramifications in the various fields of science and of philosophy. Comparative and individual studies of brain anatomy have been numerous and voluminous, and many attempts have been made at historical, evolutionary interpretation of such data.

Until now, the usual approach to this problem has been by a comparison of the brains of recent animals, on the assumption that simpler characters, or those subjectively considered primitive, are ipso facto more ancient or ancestral. "With very rare exceptions," as Edinger justly comments, "there is in the neoneuro-

logical literature no allusion to the fact that the evolutionary stages from living shark to living man do not illustrate a historical process. At best, it is assumed that the structurally progressive sequence, into which the brains of the hundreds of extant mammalian genera can be arranged, can reveal all possible modes of brain evolution in mammals." But it is not true that "brains of . . . higher mammals evolved from any brains of the living lower mammals."

The more direct approach would be, obviously, by a study of the brains of fossil animals of different ages, or rather (since the brain, itself, is never preserved) of casts of the interiors of their skulls. In mammals and birds, and less closely in lower vertebrates, these endocranial casts do reflect with measurable fidelity the gross anatomy of the brain in different lines of descent at different times in earth history. The subject has not been neglected. Even twenty years ago Edinger could collect a great body of information on fossil endocranial casts in her classic *Die fossilen Gehirne* (Berlin, 1929). Yet these observations were phylogenetically so disparate that the evolutionary interpretation had no better base than that of the comparative anatomy of recent brains. It still was true of induction from these paleoneurological data, as Edinger remarks of neoneurological studies, that "the current conception of brain evolution is . . . not based on facts but is a working hypothesis."

The actual line of evolution of a brain, from an ancient to a modern form, had never been traced in a true, genetic sequence. We have not had even one example of real progression in brain evolution, or any check on the probability that structural advance in a single phylogenetic line might differ from structural progression in diverse contemporaneous groups.

This extremely desirable example has now been brilliantly supplied. It does not seem too strong to say that Edinger's *Evolution of the Horse Brain* marks a new epoch in the study of brain evolution and a new era in the significance and broad value of paleoneurology and of paleontology in general. Painstakingly, fully, clearly, and with the highest standards of accuracy and of caution, Edinger has described and interpreted the available facts about evolution of the horse brain in the direct line from eohippus (*Hyracotherium*) to *Equus*. The data are not complete, but they are adequate for at least five major stages, well spaced from early Eocene to Recent, and they tell a remarkably full and continuous story.

The first section of the book describes and figures the specimens, in generic and temporal sequence. A second section traces the changes in different parts and structures of the brain throughout this sequence. A final summary, relatively brief but of great and general interest, not only sums up the previous detailed findings but also brings out their broad significance. The results confirm certain conclusions previously reached from the evidence of recent brains. They require the

modification of others among these conclusions, and they add much that could not be learned from the data of comparative anatomy alone.

These rich results cannot be reviewed in detail here. Perhaps the most striking discovery is the fact that the brain of eohippus was extremely primitive. In skeleton and teeth this animal had become a member of the "high," "progressive" horse family; in brain, it had barely ceased to be a reptile. The rise of the truly progressive horse type of brain, which now seems to us a diagnostic feature of the Equidae, actually occurred within that family and had nothing to do with the origin of the family. The most primitive and smallest living ungulates have far more advanced brains than eohippus, which is much closer to the opossum in this respect. Within the horse family alone, including the ancient forms, there is found almost the whole range of structural grades seen throughout the recent representatives of the whole Class Mammalia, excluding the higher primates and perhaps a few other forms. Progressive brain characters shared by recent horses and other relatively intelligent animals arose after the horses had become phylogenetically quite distinct from any other group. Horse brain evolution did not occur at a constant rate but showed periods of marked acceleration. These times of major brain change do not coincide with similar times of accelerated evolution in size, tooth or limb structure, or other non-neurological features.

These are only a few of the many provocative conclusions documented and discussed in this extraordinarily fundamental study. For anyone interested in the mammalian brain or in the course and principles of evolution in general, careful reading of this basic work is obligatory and will be richly rewarding.

G. G. SIMPSON



GLACIAL GEOLOGY and the Pleistocene Epoch.

By Richard Foster Flint. John Wiley & Sons, New York; Chapman & Hall, London. \$6.00. xviii + 589 pp. + 6 plates; text ill. 1947.

This work furnishes a comprehensive discussion of glaciers and glacial features based upon Flint's extensive study of recent and Pleistocene glaciation. The first part of the book is devoted to a study of glaciology, with a discussion of the mutual relations of nourishment, wastage, and flow of glacier ice and a brief description of all existing glaciers. The next part deals with glacial erosion, transportation, and deposition, and contains a rather complete coverage of the various topographic, stratigraphic, and other phenomena produced by moving ice.

Over half of the volume is concerned with the Pleistocene epoch, including an interesting chapter on the terminology of post-Pliocene stratigraphy. In addition to the Pleistocene stratigraphy, there is a short chapter

on the fossil record of this time and its implications as to the climate and the presence of land bridges connecting continents. The botanical evidence of post-Pleistocene climatic changes is taken up, and a brief description of the use of pollen profiles is presented.

The author discusses the various hypotheses which have been proposed to explain climatic fluctuations, and he concludes that a combination of topographic factors with variations in the sun's radiant energy offers the most satisfactory explanation. The last 53 pages contain an extensive bibliography.

THOMAS W. AMSDEN



FORMULAIRE TECHNIQUE DU PRÉHISTORIEN. *Ce qu'il faut Savoir sur la Géologie et la Biogéographie du Quaternaire, l'Archéologie et l'Anthropologie préhistoriques. Savoir en Histoire Naturelle, Volume XVIII. Guides Techniques du Naturaliste, Volume V.*

By Raymond Furon. Paul Lechevalier, Paris. 75 fr. (paper). 122 pp. 1945.

It is a great lack that among our scientific publications in the United States there is no such cheap yet excellent series of introductory manuals as the one to which this pocket-sized volume belongs. Here is a very compact and informative introduction to the geology, biogeography, archeology, and anthropology of the Pleistocene. Into five brief chapters Furon has packed comprehensive and quite detailed discussions of glacial and periglacial phenomena, the several European glaciations, the oscillations of sea-level and the formation of terraces; the Pleistocene fauna of Europe; the prehistoric stone industries and men; synchronisms and chronology; and methods of collecting, preserving, and studying such materials. The discussion of prehistoric human types seems least up to date and adequate. Otherwise, a student who wishes to obtain a quick and rather broad, if not too profound, knowledge of the Pleistocene will find this an excellent guide.

BENTLEY GLASS



HUMAN ANCESTRY *From a Genetical Point of View.*

By R. Ruggles Gates. Harvard University Press, Cambridge. \$7.50. xvi + 422 pp. + 27 plates; ill. 1948.

This work was evidently conceived and amassed in libraries and is the product of a prodigious amount of reading and abstracting. Of particular value are the reviews of and references to the literature on the many recent finds of fossil higher primates. This enormous and previously scattered literature has been in need of compilation for some time.

The author, not being a specialist in physical anthropology, mammalian paleontology, or anatomy, quite naturally, but regrettably, cannot be expected to have

acquired the first-hand experience necessary for critical selection and guarded interpretation of the widely varying studies by others. Hence this book accepts and repeats some claims which are patently unsound and introduces some hypotheses which are more daring and original than plausible or justifiable. The author's "genetical point of view," announced in the subtitle, is apparent mostly in his preoccupation with academic questions of a taxonomic nature and his willingness to assume a genetic basis for conditions which as yet can be barely assigned very tentative phylogenetic positions.

Two opening chapters discuss the Principle of Parallel Evolution and the Evolution of the Mammals, both stressing the prevalent occurrence of similar evolutionary trends among more or less closely allied forms of life and warning that "morphological similarity is not by itself a perfect measure of degree of relationship." The latter, well-justified antidote for rash conclusions does not form the leading motive in the discussions of the subsequent chapters.

The next two chapters are entitled Evolution of the Hominidae, and Head Shapes and Their Inheritance. They present interesting reviews of a large part of the newer literature dealing with these topics, though amateurish essays are listed indiscriminately with scholarly reports. These chapters include a large, summarizing family-tree in full bloom, entitled "Scheme of Higher Primate Evolution," which in some respects is so new or naive as to be startling to primatologists. According to this partly illegible picture a thick trunk of Paleocene Lemuroidea sprouted perpendicular branches supporting the recent gibbons, siamangs and oranges and another, horizontal branch led to the Tarsiodea. The latter produced a lusty offshoot as far back as the lower Oligocene, from which point one branch rose clear to the modern Ceboidea of tropical America while other branches, though locally obscured, appear to ascend to the African apes, bifurcating in Pleistocene times, and to man, in two widely separate, strong stems, bearing at the top the names "*Homo caucasicus*, *H. africanus*, Hottentot, and Bushman" on one stem and "*H. mongoloideus*, var. *americanus*, and *H. australicus*" on the other. The four former "species" or varieties claim *Eoanthropus* and Neanderthal man among their ancestors, whereas only the latter three recent human "species" are permitted to boast of such distinguished predecessors as *Australopithecus*, *Pithecanthropus*, and *Sinanthropus*. Old World monkeys are nowhere visible in this phylogenetic jungle, but *Dryopithecus rhenanus* seems to have evolved two times on widely separate branches and at different times. In these chapters the author also develops his theory of "gorilloid" and of "orangoid" lines of human evolution which "indicate parallel developments in the human strains, as regards the production or failure to produce superciliary and occipital tori." This theory, like certain other hazardous pronouncements on primate evolution, will be fated to reappear in new versions for as

long as bibliophiles write the broad generalizations of science while investigators are absorbed in discovering and recording new detailed facts. Gates could not resist the romantic appeal of the many sweeping, pseudo-scientific conclusions based upon endocranial casts of fossils, even though he refers briefly to Hirschler's recent, critical study which confirmed the suspicions of others that these casts rarely justify the extravagant deductions indulged in by some authors.

Five further chapters are focused on Modern Racial Types and their evolution. One of these chapters attempts to trace the descent of the Australian aborigines from *Pithecanthropus*, another chapter deals with human evolution in parts of Africa, still another with the early history of man in Europe, starting with *Eoanthropus*. The fourth of these chapters is boldly called From *Sinanthropus* to the American Indians, and the fifth is devoted to Polynesians, Melanesians and Negroes. These fairly comprehensive literary compositions, sprinkled with many technical details, never hesitate before those innumerable anthropological puzzles on which scholars have spent years of work only to admit that it is too early, if not too late, for final solutions. There is hardly a page without some blunt statement liable to cause specialists to groan. To mention only a few of many examples: the Ituri forest pygmies are glibly called "achondroplastic" without the slightest attempt to support such a highly questionable diagnosis. The misnamed "pygmy chimpanzee" the author unhesitatingly labels "ateleiotic" and the actually average-sized orang, recorded by Osman Hill, he honors with the title of "a contemporary giant of that species." In an earlier chapter the author has stated that the chimpanzee "is more than twice as large" as the gibbon, when "at least eight times larger" would represent the actual comparison. A list of the great many other factual errors, new or copied from the literature, is not necessary here to warn the reader that this book, with its many defects, is only an attempt to sketch man's evolution as seen by one ardent reader of the pertinent literature.

Two final chapters on Some Principles on Speciation in Primates, and on Paleontology, Speciation, and Sterility are stimulating essays on the nature of species, but they seem somewhat like *moutarde après dîner* at the end of this book. Among many interesting and valuable notes and comments one encounters unsupported and very doubtful claims in these chapters, such as: The mountain gorilla is "almost entirely terrestrial while *G. gorilla* is more arboreal. This difference in habits corresponds with the differences in the foot." "There seems no reason why the male gorilla should not cross with the female chimpanzee." Such matchmaking between a 500 lb. gorilla and a 100 lb. chimpanzee is somewhat horrifying to imagine and might at least have been tempered with a request for artificial insemination.

The very last paragraph rises to the following con-

clusions: "Since sterility fails as the criterion of species, we have to rely on the traditional basis of morphological difference in the discrimination of species, including man. We have already seen that many species and several genera of Hominidae have existed in the past, and it is clear that we must apply to man the same criteria of species that we apply to the apes and monkeys. Consistency in nomenclature and methods of classification thus necessitates the recognition of several species of living man." Incredible as it seems, it is still necessary to emphasize that the antiquated concept of the impossibility of crossing between different species has long ago been deeply buried under tons of unassailable facts. Among primates alone a great variety of interspecific hybrids have become known (though they are not referred to in this book) and new ones are being added rapidly wherever primates are kept captive under suitable conditions.

As indicated above, the outstanding contribution of this volume consists of the long and conscientiously prepared lists of references after each chapter, even though these lists are far from complete nor to be regarded as strictly "selected."

The author as well as the publishers are to be commended for their courage in undertaking this work on a subject which is as yet quite incompletely known, imperfectly understood, and open to constant revision to account for the rapid accumulation of newly discovered facts. As it is a quite tentative interpretation of its subject and since few technical matters are explained in popular terms, this is not a book for the layman.

A. H. SCHULTZ



BIBLIOGRAPHY AND INDEX OF GEOLOGY EXCLUSIVE OF NORTH AMERICA. Volume 11—1945-1946.

By Marie Siegrist and Eleanor Tatge. *Geological Society of America, New York*. \$3.25. xviii + 474 pp. + 1 plate. 1947.

A continuation of the superb index of geological and paleontological literature started by the late John M. Nickles (cf. Q. R. B. 21: 371. 1946). A memorial sketch of Nickles is included in this volume.



GENETICS AND CYTOLOGY

L'ORIGINE DES CELLULES REPRODUCTRICES et la Problème de la Lignée Germinale. *Collection des Actualités Biologiques*.

By L. Bounoure. Preface by P. Bouin. Gauthier-Villars, Paris. 200 fr. (paper). xii + 271 pp.; text ill. 1939.

Bounoure has presented a survey of the Keimbahn problem in a book that combines the best German tradition of methodical thoroughness with an admirable

French clarity (as befits a man from Strasbourg). The first section of the book is an informative historical introduction which gives due place not only to the work of Weismann but also to that of his predecessors, Owen, Jager, and others, and more especially to Nussbaum, who fathered the theory and first supported it with facts.

The bulk of the book is devoted to a survey of the data regarding the germ cells and their origin, arranged by taxonomic groups from the protozoa to the vertebrates. Special interest naturally attaches to the illustrated chapter on Bounoure's own investigation into the origin of the germ cells in the frog. He traces the germ nuclei and the cytoplasmic germ cell determinants from their initial position near the vegetal pole of the uncleaved egg by special staining reactions and by radiation techniques.

The concluding chapters discuss some of the general problems involved. It may be, as Bounoure maintains, that true dedifferentiation with a return of totipotency is a biological impossibility, but many will find it difficult to believe that this has become a closed question. Others may object to a certain teleological phraseology, but that is confined to the end of the book. There is a rather summary treatment of the situation in plants and in those invertebrates in which no early segregation nor clearly demarcated germ line is apparent. This lack is doubtless made up in the author's companion volume, *Continuité germinale et reproduction agame*, which was in press when this one was published.

The present volume will probably remain as the definitive survey of the germ cell problem from its origins up to the time when it becomes merged with the general biochemical problems of differentiation. The bibliography is the most complete ever published (unless there is one in Russian unknown to the reviewer). Bounoure ends with a quotation from John Beard, himself one of the early workers in this field, that places the germ cell theory in its proper perspective. "To us as embryologists and men the formation of an embryo has appeared to be everything, the history of the germ-cells a secondary item of no particular moment. Nature, on the other hand, reverses the relative importance of the two, setting the germ-cells on the place of honour, as linking the remote past with the distant future."

GAIRDNER MOMENT



ANIMAL GENETICS AND MEDICINE.

By Hans Grüneberg, with a foreword by Sir Henry Dale. Paul B. Hoeber, New York and London.

\$5.50. xii + 296 pp.; ill. 1947.

Animal geneticists have analysed, with various degrees of completeness, the genetic causes and the developmental histories of a large number of abnormalities in laboratory rodents. Medical scientists have had to

deal with abnormalities in human beings, abnormalities which in many cases closely resemble those in rodents. Too often, the labors and objectives of these two groups—the geneticists and the medical scientists—have been unknown to each other.

Hans Grüneberg in this book has undertaken to draw these two fields together. For this task he is uniquely qualified, having had formal training in both, having been one of the chief contributors to research on animal variations of medical interest, and possessing a highly critical approach to scientific discoveries and theories. The first three chapters are devoted to discussing the concepts required for a successful union of animal genetics and medicine, namely, the difference between the statement that a disease is gene-controlled and a statement that the gene alters some specific mechanism early in development, the interplay of heredity and environment in the development of a disease, the advantages and limitations of using experimental animals for drawing inferences about human teratology, and the principles of developmental genetics. In the remaining chapters, except the last, cases of abnormal development in mice, rats, rabbits, guinea pigs, and *Peromyscus* are discussed in as much detail as the available facts and space warrant. The cases are drawn from defects of the central nervous system (pseudencephaly, syringomyelia, atocephaly, congenital hydrocephalus, brachydactyly, ataxia, epilepsy), the ear, the eye (anophthalmia, microphthalmia), endocrine organs (pituitary dwarfism), the blood (anaemia, antigens), the skeleton (short tail and other tail abnormalities, chondrodys trophy, polydactylism), the digestive tract (hare lip and cleft palate), the urogenital system, and the skin. Grüneberg is careful not to claim too much for the parallels between the animal and human cases, but he does persistently remind the reader that much more is to be learned about medical variations by the thorough analysis of similar variations in laboratory animals.

For the geneticist, this book may open up an entirely new view of the importance of his studies on the small vertebrates. For the medical scientist, it may present some hope of understanding the developmental mechanics lying behind the human variations he deals with daily. The book emphasizes the potential advances of the future as much as the notable accomplishments of the past.

EARL L. GREEN



IDENTICAL CATTLE TWINS AND CAUSES OF SPOTTED PATTERNS.

By Alan Deakin. Published by the author, Ottawa-Prescott Highway, Westboro, Ontario. 70 cents (paper). 16 pp. 1944.

CAUSES OF THE ZEBRA AND OTHER PATTERNS.

By Alan Deakin. Published by the author, Ottawa-

Prescott Highway, Westboro, Ontario. 70 cents (paper). 17 pp. 1944.

CAUSES OF COLOR PATTERNS IN PLANTS AND AN INHIBITING FACTOR HYPOTHESIS.

By Alan Deakin. Published by the author, Ottawa-Prescott Highway, Westboro, Ontario. 70 cents (paper). 24 pp. 1944.

ANIMAL GENETICS AND THE INHIBITING FACTOR HYPOTHESIS.

By Alan Deakin. Published by the author, Ottawa-Prescott Highway, Westboro, Ontario. 70 cents (paper). 24 pp. 1945.

A CRITIQUE OF MAJOR BIOLOGICAL PRINCIPLES AND THEORIES.

By Alan Deakin. Published by the author, Ottawa-Prescott Highway, Westboro, Ontario. \$1.00 (paper). 37 pp. 1946. \$3.50 for all 5 papers.



GENERAL PHYSIOLOGY

BIOELECTRIC FIELDS AND GROWTH. With a Bibliography of Continuous Bioelectric Currents and Bioelectric Fields in Animals and Plants.

By E. J. Lund and collaborators; bibliography by H. F. Rosene. The University of Texas Press, Austin. \$6.00. xiv + 391 pp.; ill. 1947.

This volume, appearing from the laboratory of Lund after a decade of silence, will be welcomed by everyone concerned with the problems of growth. A word of warning, however, should be posted at the outset. The reader must not be misled by the title into expecting a connected, logical presentation of the electrical theories of growth and the facts relevant to them. The authors did not intend to do the kind of thing Morgan did in his classic *Theory of the Gene*. On the contrary, this book is a series of research papers by Lund and a dozen co-workers presenting a mass of important new data and new techniques relating to bioelectric potentials. There is considerable discussion, although the authors state very frankly that "the significance of the concept of maintained bioelectric fields... cannot alone be judged from the facts presented in this volume but must be evaluated in relation to numerous other facts which have previously been published."

The first section of the book deals with the pattern of electric potentials measurable on the surface of individual cells of *Pilothophora* (a filamentous alga with a basal holdfast), and in the simple epithelial systems represented by the mantle of the fresh-water clam and the *Avena* coleoptile. The apical end of a *Pilothophora* cell is positive in the external circuit with respect to the basal end. The future plane of cell division can be detected long before the appearance of a cellulose cell wall. The origin of the electrical energy is held to be the living protoplasm. In the work on the clam mantle,

and throughout the book, there is considerable emphasis on the "Principle of Summation" in the production of a given potential. The following chapter, on The Electric Correlation Field and Its Variations in the Coleoptile of *Avena sativa*, and the following section, which analyses the effects of gravity on the electric field of the coleoptile, (some 97 pages in all) repeat, extend, and take issue with the work of Clark, Cholodny, Brauner and Amlong, and others in this field. In correlating the changes in electric polarity in coleoptiles with auxin theory, evidence is presented that the "transverse polarity of the cells, which results in lateral transport of auxin" (to use the words of Went and Thimann) is, in fact, an electrical polarity.

The third section of the book reinvestigates the "spontaneous" variations in potentials recorded for the onion root tip. These variations are shown to be greatest in regions of high mitotic activity. It is suggested that such fluctuations may be related to the "brain waves" of Hans Berger.

The fourth and longest section is devoted to the effects of externally applied currents on growth and polarity in onion roots and *Avena* coleoptiles. The more than twenty-five conclusions and the great mass of data do not permit easy condensation. It is shown, inter alia, that "three distinct sets of bioelectric phenomena must now be recognized in electrically polar root cells." It also appears that the "inherent polarity current" generated by a root is from four to ten times greater than would be required to move free ions in or around the cells and thus "could affect the rate and orientation of growth of cells." *Avena* coleoptiles were found to bend towards "the positive pole of the current applying circuit," but the interpretation of this fact is obscure. The scant two pages on the control of orientation and growth in reassociating cell masses of *Obelia* add little or nothing to the previous findings of Barth or of Lund himself.

The final section, on biocoulometry, describes for the first time the use of the iodine coulometer in electrophysiology, and also the procedure for continuous measurement of electric current by a microammeter. With the frog skin used, it was found that the output of electrical energy amounted to a minimum of 1% to 2% of the total energy output from all metabolic processes. This amounts to a minimum of at least 30% "coulomb efficiency," defined as the ratio of electrical output in coulombs to the coulomb equivalent of the total oxygen consumed. The high value obtained is regarded as further evidence that redox systems "in flux equilibrium are the normal mechanisms of maintained bioelectric currents in polar cells."

Undoubtedly this is a remarkable contribution to the literature on the biophysics of growth. Potentially important new techniques have been developed, and older techniques have been utilized to secure a host of new facts. The very elaborate and often exquisitely

refined methods used are presented with an attention to detail that clearly indicates the author's hope that others will repeat and extend this work. For this reason as well as because the work itself represents an enormous amount of the most painstaking effort, it is truly a pity that it was not presented in a clearer, more manageable form. For a reviewer must admit that the language is too often Germanic in verbosity, and the arguments too often facile rather than convincing. On one page, for example, the reader is asked to "note that the polarity of the system as a whole depends upon the algebraic sum of all the constituent polarities." Further down on the same page he is told "It will also be evident from the diagrams that the region of highest electrical potential determines or controls the orientation of the bioelectric field or the electric polarity of the system as a whole. From this it is evident that the fundamental biophysical problem is how the electric polarity of the field becomes established and how it is maintained." To many readers this will seem perilously close to arguing in a series of circles. And for most readers, it is not enough to say simply, "It will also be evident from the diagrams," nor to slip without more ado to the "fundamental biophysical problem." The undeniable facts are there, and they deserve to be presented and discussed in adequate and unequivocal language.

The value of the book is enhanced by Rosene's bibliography of publications on continuous bioelectric currents and bioelectric fields in animals and plants. It includes 1,406 titles and a subject index.

GAIRDNER MOMENT



GENERAL AND SYSTEMATIC BOTANY

THE GRASSES OF BURMA.

By D. Rhind. Published under the authority of the Government of Burma, Baptist Mission Press, Calcutta, India. Rs. 5/- or 7s. 6d. 99 pp. 1945.

The author, formerly economic botanist at the Mandalay Agricultural College, prepared this work in India after the Japanese invasion of Burma. Many unpublished scientific data were lost in the invasion. In December, 1941, representative sheets of grasses were sent from the Mandalay Agricultural College to Dr. N. L. Bor, Dehra Dun, India, for safe keeping and were later transferred to the Lloyd Botanic Garden, at Darjeeling. This enumeration of the grasses of Burma is based on the specimens from Mandalay, on the Burma collections in Dehra Dun and Darjeeling, and on the bamboo collections in the Royal Botanic Gardens, Sibpur, Calcutta. The object in publishing a necessarily incomplete enumeration was largely to save the accumulated knowledge from further loss. Burma has not been extensively explored except for its economic plants. Relatively little had been published on

the grasses of Burma and that little is scattered, mostly out of date, and only available in large libraries. "Burma is a land wreathed in bamboos. The Burman's whole existence is bound up with bamboos. They are everywhere and enter into almost every phase of life and commerce." The bamboos, of which 17 genera and 69 species are described (besides 16 doubtful species listed) are more fully treated than the smaller grasses. There are 132 grass genera, divided into 20 tribes. Keys are given to tribes, genera, and species, and those species of which descriptions are not readily available in current works are described. Notes on habitat and distribution are added. Genera to be expected in Burma are included in the keys, and names, in parentheses, and notes on species found across the borders are added. A list of fungi recorded on grasses (the host given where known), compiled by L. N. Seth and B. B. Mundkur, a glossary, bibliography, an extensive list of vernacular names, and a good index complete a very useful work. The introduction gives a general account of the grass flora of the country.

AGNES CHASE



FLOWERS OF PRAIRIE AND WOODLAND.

By Edith S. Clements. The H. W. Wilson Company, New York. \$2.25. iv + 83 pp. + 25 plates. 1947.

This is a non-technical book about the flowers of the prairies and woodlands of the United States, with particular emphasis given to those of the Middle West. The twenty-four beautifully colored plates, previously published in the National Geographic Magazine, are done in the manner of the older botanical journals of the early 1800's, and together with the simple text, they provide an attractive and useful means of becoming acquainted with the native flora. Botanical jargon has been eliminated entirely, without, however, rendering the volume awkward or inadequate even to the technically-trained individual. It has much to recommend it.

C. P. SWANSON



LET'S LOOK AT THE PLANT WORLD. *An Observational Record of the Forces and Factors Behind the Phenomena of Plant Life.*

By David S. Marx. The Botanic Publishing Company, Cincinnati. \$3.00 (paper). 16 pp. + 150 plates. 1942.

Like other volumes by the same author, this is a loose-leaf, mimeographed book, written for the teen-ager, and illustrated in black-and-white ink prints. It is concerned principally with the structure and function of the various plant parts, simply presented, and profusely illustrated. Except for the leaf prints, which are excellent, the illustrations of fruits and inflorescences are

poor and of little use for purposes of identification. While of some value for supplementary reading on a high school level, the book cannot be recommended as a textbook because of the inadequacy of the subject matter for teaching purposes.

C. P. SWANSON



THE AMERICAN BOOK OF THE WOODS. *Prints and Uses of 256 Trees, Shrubs, Herbs and Vines.*

By David S. Marx; ill. by Philip D. Spiess and Philip Pfeiffer. The Botanic Publishing Company, Cincinnati. \$2.50 (paper). 27 pp. + 45 plates. 1940. The enjoyment of our natural surroundings increases as we become better acquainted with its component parts, and the uses which have been, or can be, made of them. The recent and much-needed emphasis placed upon the conservation of our woodlands, our fields and streams, and our wild plant and animal life, accentuates the point that only through proper education can these facts be brought home. This volume, presented in loose-leaf, mimeographed form, and designed for the teen-ager, is an admirable attempt to give to the younger generation a panoramic view of American plants and their place in our everyday life. It should be an excellent source book for nature-study groups, as it contains the leaf prints and the uses of over 250 trees, shrubs, herbs, and vines. The sections of the book are arranged according to the uses made of the plants. To be effective, however, the material would have to be reinforced by access to other sources of information, for the presentations are too sketchy to be of use by themselves.

C. P. SWANSON



LEARN THE TREES FROM LEAF PRINTS.

By David S. Marx. The Botanic Publishing Company, Cincinnati. \$1.25 (paper). v + 38 plates. 1938; 1945.

To call plants by name, as well as to enjoy their beauty, is a satisfying experience. Since the floral parts of many of our native and introduced trees are inconspicuous, their readily recognizable hallmarks are their leaves. The leaf prints, of natural size, shape, and venation, mimeographed on detachable sheets, provide accurate examples for comparative purposes of identification. The usefulness of such a leaf-print system is considerable to a beginner, but value of the book is marred by lack of a simple and workable key. The distinguishing features of the gymnosperms, as compared to the clarity of the angiosperm leaf prints, are such as to make them useable only with difficulty.

C. P. SWANSON

THE AMERICAN SPECIES OF HYMENOPHYLLUM SECTION SPHAEROCIONIUM. *Contributions from the United States National Herbarium, Volume 29, Part 3.*

By C. V. Morion. United States National Museum, Smithsonian Institution, Washington, D. C. 30 cents (paper). viii + pp. 139-201. 1947.

This revision of a group of American ferns lists 52 species, of which 12 are new. New varieties, 7; new forms, 1.



A PRELIMINARY SURVEY OF BRYOLOGICAL RESEARCH IN QUEBEC. *Contributions de l'Institut Botanique de l'Université de Montréal, Number 61.*

By James Kucyniak. Institut Botanique, Université de Montréal, Montréal. 25 cents (paper). Pp. 127-140. 1946.



ECONOMIC BOTANY

VIRUSES AND VIRUS DISEASE OF PLANTS.

By Melville Thurston Cook. Burgess Publishing Company, Minneapolis. \$4.00 (paper). x + 244 pp.; ill. 1947.

Published in the author's 78th year, this book is a fitting climax to his fifty years as teacher and investigator, with much of this time devoted to the viruses. Cook is one of the pioneers of plant pathology. He has observed and participated in the history of this young science from its beginnings in America. He is more biologist than many phytopathologists in these days when chemistry and physics dominate the scene and when there is danger of losing sight of the fact that the basis of understanding viruses is their biological activity as agents of disease. The book must be appreciated in the light of these facts.

The pattern of the book resembles Bawden's *Plant Viruses and Virus Diseases* or Smith's *Recent Advances in the Plant Viruses*. As in these, the reader will not find thorough outlines or discussions of particular viruses and the diseases they cause, but rather a very extensive assembly of facts, based on a bibliography of some 1400 titles, arranged according to the principles of plant virology, and "intended as a historical review and guide." It presents the most comprehensive panorama of the development of plant virology from 1576 to 1940 available. The false scents and blunders of early virology are duly recounted. They show the gradual building up of the subject, and in some cases they may prevent students repeating errors of the past. There are occasional section summaries but the author is "more interested in studying and understanding the works of others than in entering into controversies" and is reluctant to intrude his own viewpoints lest he "prejudice the students in their progress."

Particularly valuable are the purely biological chapters that deal with plant reactions to viruses and virus transmission, which together constitute half of the text. Other chapters concern the nature and properties of plant viruses with relatively little emphasis on physical and chemical properties. The very detailed table of contents compensates for a rather limited index. A unique feature is the 6-page chronology of landmarks in plant virus research.

K. STARR CHESTER



THE GREAT FOREST.

By Richard G. Lillard. Alfred A. Knopf, New York. \$5.00. x + 430 + xiv pp. + 24 plates; text ill. 1947.

This is a remarkably well-told story of the great forest that the early settlers found when they landed in America. It is also the story of the many ways in which the forest served these people and later the nation, and, in turn, a story of the treatment that the forest received. It is a fascinating story which leaves the reader with the conviction that "this is the way it was." The subject is large, and the account covers a period of more than 300 years.

The first part (Chapter titles: The Backwoods System; Hunting in the Wilderness; Bloody Course of Empire; Sunshine on the Land; Cabin in the Clearing; Fever and Fire) deals with the life of the settler, the hunter, and the Indian fighter in the Great Forest. Here is real Americana!

The second part (Subsidy for Independence; Broad Arrow; Harvest for Progress; Round Forties; Baronies in the Making; Lumberjack, Riverhog and Raftsman) traces the rise of the lumber industry and what happened to the Great Forest.

In the third part (Rebellious Countryside; Crusade for Conservation; Protest from Labor; Forest in the Machine Age) is found an excellent and accurate account of the beginning and development of the conservation movement.

A list of large American trees, selected from the records of the American Forestry Association, is included in the Appendix. Data on circumference, crown spread, height, and location of specimens of 79 species are presented. Sources of principal quotations, an extensive bibliography, and an adequate index add to the value of the work as a reference. The student of conservation, the historian, and the general reader will find in *The Great Forest* an authentic and absorbing account of how people and forests have gotten on together in America.

H. J. LUTZ



GUARDIANS OF THE FOREST.

By Stacy Klingersmith. Dorrance and Company,

Philadelphia. \$3.00. 175 pp. + 25 plates. 1947. For several years the writer of this book has devoted her time to teaching young boys and girls to appreciate trees and forests. A Tree Club, said now to have branches in ten states, was formed by Miss Klingersmith to stimulate interest in the conservation of trees.

Guardians of the Forest is written in the form of a diary. The style is conversational. Each of the thirteen chapters is based on experiences of the writer and a group of youthful Nature lovers during walks in the woods of southern Michigan. The excellent full-page illustrations are placed together at the beginning of the book.

This book will probably have its principal appeal to young boys and girls, and to adults who serve as leaders of Boy Scout or Girl Scout groups.

H. J. LUTZ



FRAGRANT HERBS. *The Botanic Handy Books.*

By David S. Marx. The Botanic Publishing Company, Cincinnati. 25 cents (paper). 64 pp.; ill. 1943.

The old-fashioned garden was never without its herbs, and the fragrance and flavor they imparted to culinary offerings helped to offset the monotony of the colonial vegetable diet. Fifty-five of those fragrant herbs are pictured in this handbook, the leaf illustrations affording a means of ready identification. The uses to which the herbs can be put are also mentioned, but only in passing.

C. P. SWANSON



TRANSMISSION OF POTATO VIRUS DISEASES. 5. *Aphid Populations, Resistance, and Tolerance of Potato Varieties to Leaf Roll. Bulletin Number 196.*

By J. G. Bald, D. O. Norris, and G. A. H. Helson. Council for Scientific and Industrial Research, Melbourne, Commonwealth of Australia. Free upon request. 32 pp. 1946.



PLANT MORPHOLOGY

AN INTRODUCTION TO PLANT ANATOMY. *McGraw-Hill Publications in the Botanical Sciences. Second Edition.*

By Arthur J. Eames and Laurence H. MacDaniels. McGraw-Hill Book Company, New York and London. \$4.50. xviii + 427 pp.; ill. 1947.

The issuance of the second edition of a book 22 years after its first printing, and in a field of science in which it enjoys an almost monopolistic coverage, is ample evidence of the maturity and static quality—one might almost say, senility—of plant anatomy, a statement

which, in these days of experimental approaches, might be made of almost any field of endeavor which is largely descriptive. This is borne out by the fact that the authors, in rewriting the text, have found it unnecessary to alter, in any way, the original chapter headings,—new material, such as it is, being readily incorporated into the earlier data. The only exception is that the historical chapter, for reasons of space, has been omitted. The paucity of recent work in some of the chapters (e.g., the chapter on the stem has no references later than 1930) is clearly indicative of the lack of interest in the field, drawing, as it does, fewer and fewer of the younger botanists into its fold.

The volume, however, is indispensable for any botanist, since it contains the basic information that underlies any experimental studies in plant anatomy. This is particularly true for those interested in anatomical evolution, taxonomic modifications as illustrated in cellular structures, and in experimental morphology. It is encouraging therefore to note the expansive treatment given the chapters on the cell, the meristem, and the floral anatomy, for it is probably in these special fields that future anatomical research will be most productive.

C. P. SWANSON



PLANT PHYSIOLOGY

THE USE OF AUXINS IN THE ROOTING OF WOODY CUTTINGS. *Maria Moors Cabot Foundation, Publication Number 1.*

By Kenneth V. Thimann and Jane Behnke. Published under the auspices of the Harvard Forest, Petersham, Massachusetts. \$1.00 (paper). iv + 272 pp. 1947.

In this compilation the authors have brought together in tabular form all available data of a quantitative or semi-quantitative nature pertaining to the effect of auxins on the rooting of woody plant cuttings. Included are some unpublished data from the authors' laboratory. The bibliography covers the literature to June 1947 and contains 291 references. Thus the book exceeds in scope all previous summaries of its kind.

FRANCIS HAXO



GENERAL AND SYSTEMATIC ZOOLOGY

TEXTBOOK OF GENERAL ZOOLOGY. *Fourth Edition.*

By Winterton C. Curtis and Mary J. Guthrie. John Wiley & Sons, New York; Chapman & Hall, London. \$4.50. xx + 794 pp.; ill. 1947.

This excellent and widely known college textbook of zoology (cf. Q. R. B. 9: 111. 1934; 14: 244. 1939) has again been carefully revised and brought up to date.

The influence of recent revision of the invertebrate phyla is apparent in such changes as the replacement of the Nematelminthes and Rotifera by the new composite phylum Aschelminthes. A chapter on the comparative structure of invertebrate systems has been added. There is ample evidence that the work of revision has been painstaking and thorough.

BENTLEY GLASS



TEXTBOOK OF ZOOLOGY. *Second Edition.*

By George Edwin Potter. The C. V. Mosby Company, St. Louis. \$5.00. 948 pp.; ill. 1947.

In this new edition (cf. Q. R. B. 14: 244. 1939), chapters on the Annelida (J. Teague Self), Genetics and Eugenics (Frank G. Brooks), The Endocrine Glands and Their Functions, and the Phylogenetic Relations of Animal Groups have undergone the main revisions. A short chapter on Mammalian Development has been added. The major portion of the book (28 chapters) is devoted to a rich survey of the animal kingdom, group by group, in detail beyond that of comparable textbooks. But other aspects of animal biology have not been neglected. The over-all treatment of evolution is the weakest element of the book. The illustrations, particularly the halftones, suffer from the quality of paper used.

BENTLEY GLASS



LABORATORY TEXT IN ELEMENTARY ZOOLOGY.

By Clair A. Hannum and William H. Brown. Stanford University Press, Stanford University, California; Humphrey Milford, Oxford University Press, London. \$1.50 (paper). viii + 180 pp.; ill. 1939.

The contents of this manual are divided into five sections, the first of which is an introduction to general laboratory procedure. The second section introduces the student to the microscope, its parts and its use. A typical cell (liver of *Necturus*) and cells undergoing mitotic division (*Ascaris*) are the first two subjects studied by the student. The third section is entitled a general survey of an animal (frog) and requires work on the external and internal anatomy. Included here are simple problems and exercises in digestion, diffusion, and muscle action. The fourth part is a general survey of the animal kingdom, with the usual descriptions of the common laboratory types. The last part discusses the principles of classification and includes a key to the phyla and classes. There is an index and an appendix of reagents used in the experimental work. Anyone interested in this method of organization and presentation will find this manual useful.

HENRI C. SEIBERT

GENERAL ZOOLOGY LABORATORY GUIDE. *Third Edition.*

By J. E. Wodsdalek. Wm. C. Brown Company, Dubuque, Iowa. \$2.75 (paper). vi + 250 pp.; ill. 1946.

This workbook is intended for a full year's course in general zoology at the college level. The writer, reflecting the opinions of the Zoology Department of the University of Minnesota, believes that too much emphasis is placed on laboratory drawings, and he therefore alleviates this burden by providing numerous drawings and diagrams. Many other figures are also included, being intended to clarify the parts of laboratory exercises that have proved to be perennial stumbling blocks and have consumed time out of all proportion to their real value. Since there is such a liberal provision of drawings, grades must necessarily be based upon what the student has comprehended and not drawn; this is accomplished by practical examinations. The sequence adopted begins with elementary cytology and histology and works up the phylogenetic scale, using several examples in each phylum. The chordates include amphioxus, lamprey, shark, frog, fetal pig, and elements of chick embryology. The drawings are good and the entire guide gives evidence of being the culmination of a long and thoughtful experience.

HENRI C. SEIBERT

A LABORATORY GUIDE FOR GENERAL ZOOLOGY *With the Mammal as the Vertebrate Type.*

By Raymond M. Cable and Clarence J. Goodnight. Burgess Publishing Company, Minneapolis. \$1.25 (looseleaf pages). v + 51 pp. + 30 plates. 1947.

Faced with the problem of offering a one-semester course in general zoology with one 3-hour laboratory period per week, the writers have prepared this manual to meet such a requirement. The procedure adopted differs from standard practices in most beginning zoology laboratories. The student first studies the organ systems (skeleton of the cat; internal anatomy of the rat), then proceeds with microscopic investigation of the cell, mitosis, gametogenesis, etc. This is followed by studies of the protozoa, flatworms, annelids, and arthropods, concluding with a survey of the animal kingdom. The second half of the manual contains a series of drawings of parts observed, which the student is required to label. At this point the student can be tested by having him label the drawings from memory or with the specimen in front of him. This procedure requires that the plates be turned in at the first period and redistributed to the students as needed. The drawings are well executed, and the manual will be useful to those who desire to follow its method of presentation.

HENRI C. SEIBERT

A MONOGRAPH OF THE EXISTING CRINOIDS. *Volume 1, The Comatulids. Part 4b.—Superfamily Mariametrida (concluded—the family Colobometridae) and Superfamily Tropiometrida (except the families Thalassometridae and Charitometridae).* Smithsonian Institution, United States National Museum Bulletin 82.

By Austin Hobart Clark. United States National Museum, Smithsonian Institution, Washington, D. C. \$2.75 (paper). viii + 473 pp. + 43 plates. 1947.

A. H. Clark is writing a series of comprehensive monographs on the living crinoids, of which this is the fourth part. All of these to date, including the present volume, deal with the comatulids or unstalked crinoids. The present paper contains a systematic discussion of 5 families, the Colobometridae, Tropiometridae, Calometridae, Ptilometridae, and Asterometridae. Twenty-eight genera are described, of which 2 are new.

THOMAS W. AMSDEN

CATALOGUE OF NORTH AMERICAN BEETLES OF THE FAMILY CLERIDAE. *Fiddiana: Zoology, Volume 32, Number 2.*

By Albert B. Wolcott. Chicago Natural History Museum, Chicago. 75 cents (paper). Pp. 59–105. 1947.

The author, a well known authority on the North American Cleridae, has prepared an excellent catalogue which will be very useful for students working with this family. The introduction mentions former lists in order of publication, and gives an explanation for some changes in classification. The family Cleridae is divided into 7 subfamilies, 34 genera, and 267 species, as well as a number of varieties. References are given for all genera, species, varieties, and synonyms. Genotypes are given under genera, and the distribution is given for each species. A complete systematic bibliography for North American forms is given in the back, and also an index.

JOSEF N. KNULL

REVIEW OF THE WEEVILS OF THE TRIBE OPHRYSIN^I OF AMERICA NORTH OF MEXICO. *Proceedings of the United States National Museum, Volume 96. Publication Number 3207.*

By A. C. Davis. United States National Museum, Smithsonian Institution, Washington, D. C. Paper. Pp. 483–551; ill. 1947.

A GENERIC REVISION OF THE ICHNEUMON-FLIES OF THE TRIBE OPHIONINI. *Proceedings of the United States National Museum, Volume 96. Publication Number 3206.*

By R. A. Cushman. United States National Museum, Smithsonian Institution, Washington, D. C. Paper. Pp. 417–482 + 8 plates. 1947.

ALASKA'S ANIMALS AND FISHES.

By Frank Dufresne; illustrated by Bob Hines. A. S. Barnes and Company, New York. \$5.00. xviii + 297 pp. + 12 plates; text ill. 1946.

Here is an exceptionally fine book, the first complete work of its kind to cover the animal and fish life of Alaska. Written in an engaging style, it imparts the savor of the outdoors while describing the appearance, habits, and distribution of Alaska's mammals and fishes. The reviewer concurs enthusiastically with Alexander Wetmore's statement in the Foreword that "the present volume is one to have on any naturalist's library shelf, one that will be appreciated by nature lovers everywhere, whether or not they have traveled in our great territory in the north, or whether or not they ever expect to go there, a book that will be read and enjoyed for its direct and vivid presentation as well as for its authoritative information on its subject." It is a book that should also interest fishermen and big game hunters, for it contains much valuable information bearing directly on those sports.

Beginning with a description of Alaska, its geography and climate, the author progresses to a consideration of Alaska's animals of the Pleistocene and then discusses in turn the big game, the fur trade, the rodents, shrews, bats, seals, whales, porpoises, and fishes. For each species described there is given such information as the range, nesting or breeding habits, care of the young, population densities, and varied ecological information bearing on predators, aggregations, migrations, hibernation, changes in pelage, size attained, etc.

The volume is beautifully and refreshingly illustrated by Bob Hines with plates in color and numerous pencil and pen-and-ink drawings. It is well bound and handsomely printed.

V. G. DETHIER

ANGLER'S CHOICE: *An Anthology of American Trout Fishing.*

Edited by Howard T. Walden II. The Macmillan Company, New York. \$3.75. viii + 326 pp. 1947.

If you are a biologist who is also a fisherman, especially a trout fisherman, you will enjoy this anthology; if you are not, you will not.

The thirty selections are varied enough to include material from Bliss Perry's "Fishing with a Worm," Peterson's "No Life So Happy," and Ed Zern's "To Hell With Fishing," along with more technical pages from George La Branche, Ray Bergman, and others.

GAIRDNER MOMENT

FISHES OF THE GREAT LAKES REGION. *Cranbrook Institute of Science Bulletin Number 26.*

By Carl L. Hubbs and Karl F. Lagler. Cranbrook Institute of Science, Bloomfield Hills, Michigan. xii + 186 pp. + 26 plates; text ill. 1947.

Previously published under the title *The Fishes of the Great Lakes and Tributary Waters*, this handbook has been revised with a view to making it more useful to a less specialized audience. Many black-and-white illustrations have been added, as well as the color plates, and the general text has been augmented. Basically the book is an illustrated key, but each species represented is discussed in a short paragraph summarizing its distribution and known natural history. There is a section on anatomical features, methods of counting, measuring, collecting and preserving, a bibliography, and an index. A map of the Great Lakes basin is used for the end papers. The work is concisely and admirably done, and the long narrow shape of the volume, while perhaps just a bit awkward to be carried in a coat pocket in brushy country, makes it handy for use on the table beside the specimens.

J. W. HEDGPETH



AMPHIBIANS AND REPTILES OF THE PACIFIC STATES.

By Gayle Pickwell. Stanford University Press, Stanford University, California. \$4.00. xiv + 236 pp. + 1 plate; text ill. 1947.

A recent reviewer, writing in a journal devoted exclusively to herpetology, valued this book as the "last word on the area covered—Washington, Oregon, and California," and the blurb on the jacket of the book states that it is a "complete reference guide to the amphibians and reptiles of the Western area." Others, particularly those taking a comparative and longer-range view of biological literature, might be inclined to couch their evaluations in more moderate terms.

West Coast youngsters interested in natural history will find this book tremendously appealing and influential. Many of our top-notch contemporaneous naturalists, in their younger days, were brought up on, and had a high regard for, Ditmar's books; Pickwell's book may serve the same purpose for the more restricted area it covers. High school students, boy scouts, college undergraduates, and others—those interested in vertebrate natural history—will probably comprise the book's widest audience.

The present work is divided into eight parts. The Introduction is short and emphasizes the use of the terms poikilothermic and homoiothermic and contrasts their meanings with earlier, and more loosely-used, terms. The next part, Amphibians of the Pacific States, is essentially an annotated systematic list devoting about a paragraph to each form; there are over 25 kinds of salamanders and a like number of anurans. The section on the Reptiles of the Pacific States similarly discusses about 10 turtles, 50 lizards, and 75 snakes. There then follow two short chapters, one on

the life habits of the amphibians of the Pacific States and the other on those of the reptiles. Topics considered include: habitat, food, reproduction, growth, and enemies. A 5-page chapter on the collecting, handling, and care of specimens precedes the collection of plates that forms the seventh part of the book. The plates show many of the species, some habitats, and selected views of various phases of the life history of several of the forms. The final chapter, titled Appendix, is a nearly 50-page key illustrated with a number of line drawings of key characters. The book is concluded with a Glossary, Bibliography (of about 115 items), and Index.

It is difficult to appraise this book, as it has many nice features and a few unfortunate ones. The Preface was quite refreshing, inasmuch as a good deal of the information about the preparation of the book was succinctly summarized and acknowledgments were freely given. In addition to the ranking herpetologists of the West Coast, thanks were offered also to a great many students and helpers whose names, otherwise, would probably never grace the pages of scientific literature. The discussions in the systematic section are, for the most part, entirely adequate for a book of this scope. A number of the photographs are quite good—particularly the one showing about two dozen *Triturus torosus* typically aggregated into a big heap in an aquarium. The key appears to be very thoughtfully constructed. It is dichotomous, with considerable information given at each choice. The addition of a Glossary is something that other semi-popular books might do well to emulate.

Most disappointing were the chapters on the life habits of the amphibians and reptiles. These chapters contain nothing particularly novel in the way of either information or presentation—but perhaps this is to be expected in a book of this type. One would have hoped for an original synthesis of the data, with an evaluation, perhaps, in terms of phylogeny. Such contributions to a general biology of these groups, particularly of the reptiles, still awaits doing.

Minor errors have crept into the book. It is inferred that in evolution amphibians gave rise to reptiles, reptiles to birds, and birds to mammals (p. 3). It is stated that the coloration of *Hyla regilla* may be brown or green, depending on the environment (p. 18), whereas it is probable, to a large extent, that other factors are involved. Pickwell has placed the turtles in the Synapsida instead of the Anapsida. In this he follows the *Check List of North American Amphibians and Reptiles* but has ignored the sound work of men like Zittel, Osborn, Williston, Case, and Romer. The eardrum is considered to be concealed in the Caudata, whereas actually it is entirely absent. Dermal glands are mentioned, where epidermal glands are meant (p. 78). The maxilla is referred to as a synonym for the upper jaw, a usage not strictly correct, since other bones are also involved. A few other definitions in the glossary could

be improved. For example, distal is described as "remote from the point of attachment or origin." The Bibliography has a few surprising omissions: Camp's *Key to the Lizards*; Blanchard's *Diadophis Monograph*; and Smith's *Handbook of Lizards*. (Perhaps the last item appeared while the present book was in press.) The style of the text is rather uneven. Contrast, for example, the rather technical passage, "The hemipenes, which are paired diverticula of the cloaca, lie in the caudal portion of the body of the male," with the quite popular style of the following: "Perhaps nature provided the Toad with many eggs so that many could be sacrificed to the whims of sun and puddles and yet there would be enough to survive in other puddles to keep our West Coast always supplied with dooryard toads." Frog, Snake, Lizard, etc., are regularly capitalized. The paragraph on the collecting of rattlesnakes is certainly too cavalier for all but experienced collectors who, quite obviously, would derive little new information from it. Dust shot, as a collecting method, is not mentioned, nor are museums or scientific collections given any space. In a paragraph on the special senses of reptiles only the eye, ear, and tongue are mentioned; among the omitted are the interesting Jacobson's Organ and the pit organ of the Crotalidae. A reader might pick up a number of misconceptions about good taxonomic procedure. The three races of *Batrachoseps pacificus* are separated in the key solely on geographic grounds. It is suggested that the forms *croceator* and *sierrae*, in the genus *Ensatina*, may intergrade; yet they are given full specific rank without further discussion. The name, *cinereous*, is placed in parenthesis after *Crotalus atrox*; these names are involved in a nomenclatorial tangle, and this method of linking them is undesirable. The book is not free of typographical errors.

All in all, this is a good book for an amateur audience. It is an attractive, interesting, and informative manual. The author, well-known for his series of pictorial books on weather, deserts, etc., marks with this book his entry into a new field. The book has much textual material and is not designed to be carried by the photographs alone, and Pickwell has had the help of outstanding authorities. If the loose ends could be brought together, this would be a volume that could be heartily recommended to amateur and professional naturalists of the West Coast alike.

ARNOLD B. GROBMAN



REPTILES AND AMPHIBIANS OF THE NORTHEASTERN STATES. A Non-Technical Résumé of the Snakes, Lizards, Turtles, Frogs, Toads, and Salamanders of the Area.

By Roger Conant. Zoological Society of Philadelphia, Philadelphia. \$1.00 (paper). 41 pp.; ill. 1947.

This is a well done non-technical review of the amphibians and reptiles of the northeastern states, defined to include New England, New Jersey, and Delaware, and those parts of New York, Pennsylvania, and Maryland that lie east of a line passing through Harrisburg and Corning.

There is a general introduction and a check list of the forms (27 kinds of snakes, 6 lizards, 16 turtles, 20 anurans, and 18 salamanders), giving their common names, scientific names, and distributions. Next is a summary of information about snakes, followed by a description and photograph of each form known from the area. The same treatment is extended to the lizards, the turtles, the frogs and toads, and the salamanders. Included under their respective groups is a special consideration of venomous snakes (and snake-bite treatment) and of baby turtles. The pamphlet concludes with an account of the care of captive specimens, a list of 25 pertinent references, and an index.

Those familiar with the Philadelphia Zoological Garden's journal, *Fauna*, will find that this article is largely a compilation of material that has already appeared there as separate papers. It is nice to have a single issue of it, for it is accurately written, up to date, and ideal for amateurs. The photographs are, almost without exception, excellent. The textual material is well handled; Conant is unusually proficient in presenting animals to the public.

Slips are rare. It is inferred that cloaca and rectum are synonymous terms (p. 25). It is also stated that eyelids are lacking in snakes (p. 12), whereas the eyelids are actually transparent and fused over the eye, giving merely the illusion of absence.

ARNOLD B. GROBMAN



THE ILLUSTRATED ENCYCLOPEDIA OF AMERICAN BIRDS, Including Key for the Rapid Identification of Birds.

By Leon Augustus Hausman; illustrated by Jacob Bates Abbott. Garden City Publishing Company, Garden City, New York. \$2.49. lxvi + 541 pp. + 16 plates; text ill. 1947.

According to the manner in which an individual defines or interprets the word "encyclopedia" will depend in large part his major criticism of this book. If a comprehensive survey of knowledge about North American birds is understood, then the reader will be disappointed; if merely a dictionary of facts, then perhaps he will be less so. "Gazetteer" would have been more appropriate than "encyclopedia." The text is essentially an alphabetically annotated list of North American species and subspecies of birds, as recognized in the fourth edition of the A. O. U. Check-List. A description of male and female plumage and of the size and distribution of each form is provided. For each species as a whole there are additional remarks on food habits,

noticeable behavior characteristics, preferred habitats and other miscellaneous information. Since the alphabetical ordering has been done on the basis of common names, related species are together only if they happen to have similar common names. Members of the same family may be widely separated (e.g., chickadee, titmouse), and even closely related species (greater scaup duck separated from the lesser scaup by the Labrador duck) or subspecies (Eastern golden-crowned kinglet from the Western by the Eastern ruby-crowned) may not follow one another. Some reprints of Fuertes' earlier paintings and numerous, rather likeable, pen-and-ink drawings illustrate the species. There is appended a list of North American birds taken from the official Check-List, and an index to other popular names, an index of scientific names of families, a list of state birds, and a bibliography of sorts.

HENRI C. SEIBERT



A PRELIMINARY LIST OF BIRDS OF MARYLAND AND THE DISTRICT OF COLUMBIA.

Compiled and annotated by Irving E. Hampe and Haven Kolb. The Natural History Society of Maryland, Baltimore. \$1.00 (paper). xii + 80 pp. + 1 plate + 1 map; text ill. 1947.

The present list contains 338 accepted forms and 27 hypothetical ones that have been recorded within the political confines of Maryland and the District of Columbia. For the most part the authors have not included in their list any forms unsubstantiated by specimens. Some sight records have been admitted if the bird was seen by at least two competent observers on more than one occasion. In several cases this has resulted in the exclusion of a few records of undoubted authenticity, but as is rightly pointed out, it is easier to add to such a list than to subtract from it once the information has appeared in print. Because its varied topography provides widely contrasting ecological conditions, the state has been divided into five major sections to facilitate discussion of distribution. These are: the Eastern Shore; southern Maryland; the Baltimore-Washington area; Central Maryland; Western Maryland. The seasonal status and distribution with regard to these five areas is given for each species and subspecies. One of the most valuable features of this book is the candor with which the authors admit a lack of information on the bird life in the state as a whole, and whenever such data is lacking, the fact is clearly pointed out. Budding students, dreaming of far away explorations, may well take heed of the inadequacy of our information concerning such a popular field as bird study even within such a densely populated area as Maryland. This useful booklet is further enhanced by a list of references, an index, and a map. The printing

of place names in the latter is unfortunately not up to the standards set by the rest of the book.

HENRI C. SEIBERT



OISEAUX DE LA RÉUNION. *Faune de L'Empire Français*, IV.

By Jacques Berlioz. Librairie Larose, Paris. 250 fr. (paper). iv + 83 pp.; ill. 1946.

Although Reunion, the westernmost of the Mascarene group of islands, was not apparently inhabited until the beginning of the 17th century, its bird life has undergone a tremendous change. Many species have become extinct since the time when DuBois visited the islands and gave an irritatingly brief account of the birds that he observed. Many more have been introduced, and as a result it is now difficult to analyse and evaluate the bird fauna. However, it seems that Reunion's bird life has always been scant, as it is on Mauritius, Rodriguez, and Madagascar, and consists mostly of primitive types of birds. Most of the perching birds are recent introductions. Of special interest is the solitaire, known only from written descriptions and some paintings presumably copied from a living model. Migratory species form a third category of birds present on the island, one which will probably increase in number as more specimens are collected. This report lists all of these birds and discusses their status on Reunion as well as neighboring islands. An introduction gives the historical background of the island, especially its former bird life, and its zoogeographic affinities.

HENRI C. SEIBERT



BIRDS OF MALAYSIA. *The Pacific World Series*.

By Jean Delacour, with line drawings by Earl L. Poole and Alexander Seidel. The Macmillan Company, New York. \$5.00. xviii + 382 pp.; ill. 1947.

With the appearance of the present volume, the trilogy of handbooks on the birds of the South Seas, Philippines, and Malaysia is completed. The area encompassed in the term Malaysia includes the Malay States as far north as the isthmus of Kra, Sumatra, Java, Bali, Borneo, Palawan, and neighboring islands. The plan followed in this book is essentially that used in the *Birds of the Philippines*, a cooperative effort of the present author and Ernst Mayr. The introduction contains very brief remarks on the history of ornithology in this region. Since so little is known about the life histories of Malaysian birds, the hints to observers that appeared in the first volume of the series are reprinted here. The Malaysian subregion and its four zoogeographic provinces are briefly described.

For nearly all families field keys to the species have been provided. The species themselves are described in

some detail, as to size, plumage coloration (of both sexes in dimorphic forms), and range. The distribution of subspecies is indicated. Here and there succinct notes on the habits of the better known birds are interpolated, but such information is meager. Migrant shore birds are only listed, and the reader is referred to Mayr's volume for further details. Some 84 line drawings by Earl Poole and Alexander Seidel illustrate many species, and for the most part they are well executed. Additional drawings would not have been amiss.

Like the other books of this series, the material gathered here is not only useful as a field guide, but also as a resumé of the variety and the distribution of the bird life in a region unfamiliar to most of us. Both of these tasks have been excellently performed. In addition to an index, there is a list of generic synonyms to facilitate reference between the generic names used in this volume and those used by Chasen in his *Handlist of Malaysian Birds*. The inside cover and fly leaf has a map of Malaysia for ready reference.

HENRI C. SEIBERT



FIELD GUIDE TO BIRDS OF THE WEST INDIES: *A Guide to All the Species of Birds Known from the Greater Antilles, Lesser Antilles and Bahama Islands*.

By James Bond, illustrated by Earl Poole. The Macmillan Company, New York. \$3.75. xii + 257 pp. + 1 plate; text ill. 1947.

Now that North America is well supplied with field guides on birds, the tendency is to spread out to foreign lands. The present manual includes the avifauna found on the Bahamas, the Greater Antilles as far south and west as Swan Island, and the Lesser Antilles to Grenada. The islands lying close to the South American continent, —Tobago, Trinidad, Curacao, etc.—are excluded, since their bird life is essentially continental. The writer, a well-known authority on birds from this area, states that he has included all the species known to inhabit or to occur within the aforementioned area. All of these species (subspecies are virtually ignored) are briefly described, in many cases with the addition of differentiating and diagnostic features. The latter information is of especial importance to the beginning student. In view of the fact that the field work in this area is hardly comparable to what has been done in North America, it will require much further experience to evaluate the reliability of these characteristics. In many instances it is assumed that the student is already familiar with North American birds, as comparisons are frequently made among birds that are more or less similar in both areas. There are useful hints on how and where to look for birds in the West Indies. For the more remote areas, a guide is recommended, and in order to facilitate the communication of ideas between the explorer and his guide, the local names of each species as well as its

songs and notes are provided. The book is indexed, possesses a map on the covers, and is liberally illustrated with line drawings by Earl Poole. All visitors to these islands, whether remotely or avidly interested in birds, will need this guide as part of their travelling equipment.

HENRI C. SEIBERT



CATALOGUE OF CANADIAN RECENT MAMMALS. *National Museum of Canada, Bulletin Number 102, Biological Series Number 31.*

By Rudolph Martin Anderson. *Department of Mines and Resources, Mines and Geology Branch; Edmond Cloutier, Ottawa.* 75 cents (paper). vi + 238 pp.; ill. 1946.

This catalogue is a distributional list of those mammals known to exist now, or to have existed within historic time, in the Dominion of Canada, Newfoundland, Greenland, and the adjacent seas. It is admittedly an incomplete list for this vast area, but it includes everything that has been recorded on good evidence up to date, thus filling a great gap in mammalogical literature that has existed only too long.

Nearly 600 mammalian species and subspecies have been recognized as indigenous in the territories considered, whereas in 1820 Desmarest could describe only 100 species inhabiting all of North America. Of the thirteen orders of mammals occurring in the northern part of the New World, only the Perissodactyla (tapirs), Xenarthra (sloths, anteaters and armadillos), and Sirenia (seacows) are not represented in Canada, and of the 64 North American families only those limited to some subtropical bats, rodents, and primates are not included in the Canadian list.

In compiling this scholarly catalogue the author has largely followed the improved sequence of orders used by the late Glover M. Allen, and has, e.g., placed the primates after the insectivores, the Cetacea after the pinnipeds, and treated the lagomorphs as a suborder of the order Rodentia. For each species and subspecies reference is made to the first publication of the respective name, and the most common synonyms are given, as well as type localities and the range, according to present knowledge.

As a basis for future and more detailed reports this monograph is of outstanding value. There are unusually few and very minor printers' errors, but there is only one illustration, showing (with too great reduction) the life zones of North America. More maps of distribution would have been very helpful.

A. H. SCHULTZ



WILD MAMMALS OF VIRGINIA.

By Charles O. Handley, Jr., and Clyde P. Patton. *Commonwealth of Virginia, Commission of Game and*

Inland Fisheries, Richmond. \$3.00. viii + 220 pp. + 1 plate; text ill. 1947.

This small but serviceable account of Virginia mammals has been written chiefly for the layman. There are simple and reliable keys for the identification of species, numerous maps of distribution, based upon as yet incomplete information, and notes, varying somewhat in scope and detail, on the behavior, ecology, etc., of many of the animals listed. The illustrations are mediocre at best, but the text is clear and well organized. It is a pleasure to read that the authors plan to continue their studies on the occurrence and distribution of mammals in Virginia and that there is hope for the restoration of species in depleted areas through improved game management and, it may be added, through much needed state-wide respect for game laws.

A. H. SCHULTZ



ECONOMIC ZOOLOGY

INSECTS AND HUMAN WELFARE. *An Account of the More Important Relations of Insects to the Health of Man, to Agriculture, and to Forestry. Revised Edition.*

By Charles T. Brues. *Harvard University Press, Cambridge.* \$2.50. xiv + 154 pp. 1947.

In this revised edition, the pleasant readable story of the ways in which insects affect the welfare of man has been brought up to date, to include some of the notable advances made in insect control since the First World War. The chapter on insects in relation to public health has been extensively revised and enlarged. Photographs have been eliminated in favor of additional charts. New material has also been added to the sections on Insects and the Food Supply, Forest Insects, and Household Insects. Those who have feared the effects on national health of returned veterans who were exposed to a plethora of tropical diseases will derive solace from the concluding chapter, The Outlook for the Future.

V. G. DETHIER



DDT and the Insect Problem.

By James C. Leary, William I. Fishbein, and Lawrence C. Salter. *McGraw-Hill Book Company, New York and London.* \$2.50. viii + 176 pp.; ill. 1946.

This is an interesting discussion of the history and use of DDT. In the introductory portion the authors point out that DDT is an insecticide, and a better one, killing more insects than any other one material has ever accomplished. There are many insects it will not control. It is not necessarily a "miracle insect killer," though it came to light at a time when it seemed miraculous—saving the lives of so many men in service and

helping to win the war. Certain characteristics of DDT are pointed out, such as its residual value, its dual (stomach and contact) insecticidal action, and the minute dosages needed to kill controllable insects. The various forms in which it can be used, its danger to plants, man, and animals, its effects upon injurious and beneficial insects as well as upon the soil, and the relation of these results to the balance of nature are also discussed. A general discussion takes up the whole question of the interrelation of insects, the losses sustained by man, the place of beneficial insects and chemicals as controls, and insect control measures used before DDT was discovered. A considerable amount of space is devoted to the chemical structure and chemistry of DDT, its toxicology to man, the problem of its solubility in fats and oils, and the question of its getting into milk produced by animals which chance to feed upon DDT-sprayed forage. The method of its action as a toxic agent upon insects and cold-blooded and warm-blooded vertebrates is treated in a general way. A rather brief portion deals with the various methods of formulation, the percentages used in sprays and dusts, and how these should be applied to control different insects. A summary is given of the uses of DDT in the war to prevent the transmission of insect-borne diseases following its discovery, the history of which is also briefly outlined. This is followed by a resumé of its use in promoting both the health and comfort of man, including methods of use and application about the house. The latter portion of the book contains a rather full account of the various uses of DDT in agriculture, its value in treating shade trees and ornamentals, and its contribution to the control of important injurious insects in fruit production.

A good bibliography is appended to each chapter. The book is written in an interesting and informative style.

DWIGHT M. DeLONG



DDT AND OTHER INSECTICIDES AND REPELLENTS DEVELOPED FOR THE ARMED FORCES. *United States Department of Agriculture Miscellaneous Publication Number 606.*

Prepared by the Orlando, Florida, Laboratory of the Bureau of Entomology and Plant Quarantine. United States Department of Agriculture, Washington, D. C. 20 cents (paper). 71 pp.; ill. 1946.

This bulletin is divided into ten parts, the first of which (Part I) is introductory and covers the summary of the developmental work of the experimentation and use of chemicals for the armed forces. Part II is the discussion of the history, chemical formulae, properties, methods of analysis, formulation and various solvents for the use of DDT, with also a brief discussion of DDT in dust form used with different diluents. Benzene hexachlo-

ride is briefly discussed, as well as the main story of repellents and miticides. Part III concerns the use of DDT in the form of larvicides for the control of anopheline and culicine mosquitoes especially. This includes the liquid and dust materials and the methods of formulation and application of oil and aqueous preparations. Part IV treats the use of DDT for the control of adult mosquitoes, mentioning especially the residual effect, equipment, and methods of application to buildings, bed nets, and vegetation. Also the use of DDT in aerosols is treated, as well as the use of concentrated spraying. Part V is concerned with airplane application of DDT. Various types of equipment for dispersion and application of sprays are discussed and illustrated. The types of planes best adapted to this work and special equipment built into the planes to give more satisfactory dispersion of sprays and dusts are described and illustrated. There is also a discussion of the evaluation of the airplane application of DDT sprays. Part VI is a brief but general discussion of the uses of DDT, especially for the control of flies, bedbugs, fleas, roaches, and a few other miscellaneous insects. Part VII supplies the information concerning the control of human lice and scabies, mentioning especially louse powders and their use in the control of body lice, impregnation of clothing, sprays for the control of lice eggs on the hairs of the body, control of head lice, crab lice, and the control of scabies. Part VIII mentions briefly the work done upon the development and use of insect repellents, pointing out especially the formulae used for the protection of the armed forces. Among those topics treated are applications of liquids and creams to the skin, the treatment and impregnation of clothing, the conditions under which repellents should be used, and the insects affected by the use of repellents. Part IX deals with protective measures against mites, the conditions under which miticides should be tested, the methods of applying them, impregnation of clothing, and the control of mites in breeding areas. In order to warn against probable dangers and irritations in the use of these materials, Part X considers the toxicity of DDT, together with its solvents, emulsifiers, activators, and other adjuvants, to man.

DWIGHT M. DeLONG



DDT: KILLER OF KILLERS.

By O. T. Zimmerman and Irvin Lavine. Industrial Research Service, Dover, New Hampshire. \$2.75. xii + 180 pp.; ill. 1946.

The appropriate title of this short book points out the sequence by which the story of DDT is here uncovered, starting with descriptions of various plagues of the past which were intimately related to the insect world and continuing to the birth of DDT, its qualities, and its effects. The seven chapters contained in the book take

up the various phases of vital interest from a historic point of view, as well as the present outlook. In the first chapter there are short descriptions on the importance of such diseases as bubonic plague, typhus, malaria, yellow fever, and Rocky Mountain spotted fever, as well as information about the first discoveries of the vectors of these diseases and subsequent attempts to control them. By this introduction the stage is set, and the great need for an insecticide such as DDT shown. Some 70 years elapsed from the time of the first synthesis of DDT by Othmar Zeidler to the work of Paul Müller in 1934 which again brought to light this most important insecticide. Work during the years of World War II has finally released DDT to the civilian population. The great loss of lives and money due to typhus during previous wars was greatly reduced by the use of DDT. The city of Naples affords an outstanding example of the new typhus control. The cautions to be employed in the use of DDT, its value, the dangers involved (including the exaggerations first propounded), and its specific usage on ants, bedbugs, fleas, flies, lice (human and animal), mosquitoes, moths, and ticks are described. Many experiments determining the toxic dosages for various types of animals are mentioned, and the difference in its toxic effects upon cold-blooded animals, which are very susceptible to DDT poisoning, and in contrast upon warm-blooded animals, which are usually relatively resistant ($\frac{1}{16}$ gr./kilogram being found a general "safety" limit), are pointed out. The various uses of DDT in household and outdoor sprays and dusts, aerosols, emulsions, and paints are described, and the approximate amounts to be used are related. Comparisons are made with other insecticides, many of which have been used for some time as general or specific materials. One fact brought out is that, of the insecticides commonly employed, DDT and sodium fluoride are the only ones to act both as stomach and contact poisons. This factor has been one of the great points in the favor of DDT, because one or the other or both qualities may be found useful in different situations.

The book is written in a light, easily read style, which should appeal to the layman as well as the scientist who wishes to have a handy reference of facts pertaining to DDT. The appendix, in two parts, is a brief summary of the text (Part I) and an agricultural use guide (Part II). Twenty-four photographs are the only illustrations.

DWIGHT M. DELONG



BIBLIOGRAPHY ON AVIATION AND ECONOMIC ENTOMOLOGY. *United States Department of Agriculture Bibliographical Bulletin Number 8.*

Compiled by Ina L. Hawes and Rose Eisenberg.

United States Department of Agriculture, Washington, D. C. 35 cents (paper). iv + 186 pp. 1947.

The references selected for inclusion in this extremely useful bibliography are those on the relation of aircraft to the control of crop pests, forest insects, and mosquitoes, to the transportation of disease vectors, together with the attendant problems of quarantine and disinfection, and to insecticidal injury to bees, livestock, etc.; aircraft studies of aerial fauna; and aerial scouting and mapping of infested areas. The literature cited covers the years 1919 through 1944. This bibliography is a revision and enlargement of the *Bibliography on the Use of Airplanes in Insect Control, 1922-1933*, compiled by W. E. McBath in 1934.

V. G. DETHIER



ANNALES BIOLOGIQUES. *Volume Number II, 1942-1945.*

Edited by H. Blegvad and A. A. J. C. Jensen. *Conseil Permanent International pour l'Exploration de la Mer, Charlottenlund Slot, Denmark; Andr. Fred. Høst & Fils, Copenhagen.* Kr. 12.00 (paper). 174 pp. + 1 chart; text ill. 1947.

The second volume of this new series is devoted to analyses of the fish populations and hydrography of the North Sea, Atlantic slope, and Baltic areas for the years 1942-45. There is also information on the deep-sea prawn.



FISH PONDS for the Farm.

By Frank C. Edminster. *Charles Scribner's Sons, New York and London.* \$3.50. xiv + 114 pp.; ill. 1947.

This book is written in a style that is not only easy to understand, but is entertaining as well. Part of this effect is achieved by keeping the chapters relatively short and yet to the point. In addition, the author is not afraid to point out difficulties or to suggest where the amateur fish culturist will need the aid of expert help. This leaves the reader with the feeling that he can confidently proceed to establish a fish pond; for it is made clear that specialized advice is not essential to most of the project and can be easily obtained from well-defined governmental sources.

The format and illustration of the book are also excellent. There can be little doubt that it will be of great practical value to anyone who wants to create a highly productive fishing pond.

JOHN E. CUSHING



POULTRY HANDBOOK. *An Encyclopedia for Good Management of All Poultry Breeds.*

Edited by Rudolph Seiden. D. Van Nostrand Company, New York. \$6.00. xviii + 410 pp.; ill. 1947. This handbook is a first encyclopedia on poultry. The information is drawn from a limited list of authentic sources, sometimes but not always from the most recent and authentic. Pronunciation and definition are given for less usual terms. Feed and other service personnel, vocational teachers and extension workers, and poultrymen will find this a useful book. The book is intentionally weighted with material on the control of diseases and parasites.

T. C. BYERLY



DOMESTIC GEESSE AND DUCKS: A Complete and Authentic Handbook and Guide for Breeders, Growers and Admirers of Domestic Geese and Ducks.

By Paul Ives; illustrated by Franklane L. Sewell, Arthur O. Schilling, and others. Orange Judd Publishing Company, New York. \$3.50. xii + 372 pp.; ill. 1947.

This book was written "for breeders, growers and admirers of domestic geese and ducks." It is an unusually readable description of the breeds and varieties, their history, their husbandry, and their preparation for the table. The account is unfettered by rules of pedagogy, scientific method, or evidence of zoological nomenclature. The illustrations include some nice pictures by Arthur O. Schilling and Franklane L. Sewell, as well as some ancient, poorly reproduced photographs from the U. S. Department of Agriculture. The author is president of the American Waterfowl Association; he knows a lot about geese and ducks. His point of view is that of a fancier and an enthusiast. The text is embellished with many literary quotations from sources ranging from McGuffey's *Reader* to Edna St. Vincent Millay. Perhaps the most appropriate to this review is one from Dickens' *The Cricket on the Hearth*—"Every man thinks his own geese are swans."

T. C. BYERLY



LA PATHOLOGIE DES OISEAUX. Two Volumes.

By G. Lesbouyries. Vigot Frères, Paris. 2000 fr. I, pp. 1-479; II, pp. 480-868; ill. 1941.

This handsome two-volume report on diseases in birds has its subject matter divided into two sections. The first, *Les Maladies*, describes the conditions resulting from avitaminosis, faulty metabolism of organic and inorganic foods, osseous dystrophies, incubation abnormalities, and tumors. Also in this category are the infectious diseases caused by viruses, bacteria, animal and plant parasites, as well as poisoning from organic and inorganic sources. The second part, *Les Affec-*

tions, includes diseases of a more local nature. These are taken up according to organ systems. First come the affections of the digestive tract, starting with the mouth and proceeding to the esophagus, crop, gizzard, etc. Then come diseases of the liver, pancreas, spleen, urinary system, genital system, the peritoneum, respiratory system, circulatory system, and finally involvements of the sensory, muscular, and cutaneous tissues. The first category goes well into the second volume and consists of 612 pages; the second category takes up the remainder of the second volume. Not all the topics are treated alike, and it is therefore impossible to make any general statement covering the mass of information packed onto each page. As one example, in the chapter on gram-positive bacteria, the sub-chapter on *Streptococcus* includes an historical resumé of the literature, notes on the classification, identification, and culture of diverse avian streptococci, clinical studies (differentiated into symptomatology, pathological anatomy, prognosis, and diagnosis), etiology (methods of infection, resistance, pathogenesis, etc.), treatment and prophylaxis. Plates provide further details of gross and histo-pathology.

From such general statements it should be apparent that this is a work of major importance. Except for one, the following criticisms are mostly picayune. The title is slightly misleading, since the subject matter is mostly devoted to the chicken and to a lesser extent to ducks, turkeys, and other domestic birds. Only rarely are wild birds mentioned. In some places citations have an eye-catching number of misspelled names (Adamson for Adamstone; Klambach for Kalmbach; Mayer for Meyer, etc.). But the major fault, indeed an unfortunate one, is the omission of a bibliography in spite of the hundreds of citations in the text. The excuse given is that a bibliography should be complete, which it seldom is, and that in a book which refers to all the illnesses of several species of animals, the size and importance of such a bibliography would submerge the text. The reviewer does not subscribe to this thesis and feels that this splendid work loses considerable value thereby.

All veterinarians and husbandrymen concerned with domestic fowls will nevertheless find occasion to refer to this publication, and its author is to be congratulated upon a significant achievement, especially in view of a short statement made at the end of the introduction: "Notre reconnaissance vis-à-vis de nos éditeurs est d'autant plus vive que notre traité devait paraître en 1940 et qu'il fut totalement détruit par action de guerre alors qu'il était à l'impression. Malgré la lourde perte subie, MM. Vigot Frères nous ont demandé de reprendre notre travail avec les notes et les figures que nous avions pu conserver. Oubliant l'amertume du destin, nous avons associé nos courages et nos espérances pour présenter à nos lecteurs la *Pathologie des Oiseaux*."

HENRI C. SEIBERT

THE RELATION OF DISEASES IN THE LOWER ANIMALS TO HUMAN WELFARE. *Annals of The New York Academy of Sciences, Volume XLVIII, Article 6.*

By William A. Hagan, Herald R. Cox, William H. Feldman, I. Forest Huddleson, Harald N. Johnson, Raymond A. Kelsner, Joseph V. Klauder, Karl F. Meyer, C. D. Stein, and Willard H. Wright. *The New York Academy of Sciences, New York.* \$2.50 (paper). Pp. 351-576 + 11 plates. 1947.

This series of papers does not include all the diseases that man is capable of contracting from other animals, but the most important ones are represented. Rabies, equine encephalomyelitis, psittacosis and ornithosis, brucellosis, plague, tuberculosis, anthrax, animal parasites, and a bacterium called *Erysipelothrix rhusiopathiae* are the subjects of the separate papers. Since each of these diseases is reviewed by an experienced investigator in the field, the net result is a competent, condensed, and up to date resumé of the economic losses, dangers to man, and the progress in control and eradication. To those not intimately associated with this field of endeavor, it may be an eye-opener to discover the high incidence of diseases that can be carried over to man prevalent among animals with which man has close contact. Biologists in other branches of the science can pleasantly brush up on one phase of their college parasitology and bacteriology by going through this highly readable publication.

HENRI C. SEIBERT



MANUEL DU PIÈGEUR: *Moins de Nuisibles, Plus de Gibier. Second Edition.*

By André Chaigneau, with preface by V. Mairesse. Payot, Paris. 100 fr. (paper). 230 pp.; ill. 1943.

Anyone concerned with the elimination of vermin, for whatever reason, will find in this manual descriptions of a host of methods for doing so. Shooting, poisoning, gassing, and trapping are described, the former and latter being the recommended methods. Each is elaborated in great detail, with information on the best instruments to use, where to use them, when, and how. For instance, the section on trapping is divided into technique and tactics. The former describes steel, box, and homemade traps; the latter includes choice of traps, the qualities of a good trapper, and how to take advantage of the habits of animals. Over 100 different traps are described, and each kind is criticised as to its usefulness, applicability, and other features. In all, the manual is replete with information. Sketches made by the writer illustrate many models, positions, and tricks useful in the trade. Although for the most part helpful, a few sketches are not very clear and were incomprehensible to the reviewer (who is no trapper). The section on poisons does not mention any of the more recent products.

This manual would receive complete approval for its wealth of data and undoubted usefulness, were it not for its attitude perhaps best expressed in the subtitle—"moins de nuisibles, plus de gibier." The idea that by eliminating skunks, foxes, weasels, badgers (European), hedgehogs, birds of prey, jays, crows, etc., game will benefit is one that is rapidly losing ground and is based more on tradition than on facts. However, should some occasion arise when these animals need to be removed, there is plenty of information here as to how to do it.

HENRI C. SEIBERT



BRITISH DAIRYING.

By Frank H. Garner. Longmans, Green and Company, London, New York, and Toronto. 21s; \$5.50. 263 pp. + 39 plates. 1946.

This book presents the story of milk production and dairy farming in the British Isles. It "has been written to assist farmers today and in the future to meet the public demand." A brief but informative history relating to the industry is told. Throughout the ages man has consumed milk or dairy products, and without doubt the demand for these products played a large part in the domestication of animals. The biggest development in the liquid milk trade came after 1850 with the developments facilitating transportation. Other changes credited with influencing developments in milk production include improved handling of milk at farms, the demand for cleaner milk which began after World War I, the development of the science of dairy bacteriology, the sale of graded milk, the increased emphasis given to health of cows, the introduction of the panel scheme for dairy cows, and the sale of milk in bottles. Likewise, changes have occurred in butter production. After 1850 the nature of the butter industry changed from a chore performed by the farmer's wife and daughters to the manufacture of butter in factories. These changes were facilitated by the invention of the centrifugal separator, use of the Babcock test, and developments in dairy chemistry. Cheese-making, too, has moved from the farm to the factory—but only recently.

Improvements in breeding and feeding practices are discussed briefly—including licensing of bulls, proven sires, and Registry of Merit requirements. The various breeds of dairy cattle are discussed as to characteristics and qualities. Illustrations throughout the book are good.

Feeding stuffs used in the British Isles are catalogued and their use is elaborated. Diseases and pests of dairy cattle are discussed in a style for the farmer. Practices for raising calves, for handling stock in the store period, and for management of cows in production are given. Brief space is given to costs and returns. The author concludes with a discussion of systems of dairy farming.

and advice to the beginner. An adequate index is supplied.

W. A. CRAFT



THE BREEDING OF FARM ANIMALS.

By Chapman Pincher. *Penguin Books, Harmondsworth, Middlesex, England, and New York.* 1s. (paper). 149 pp. + 4 plates; text ill. 1946.

This small booklet, written in a lively style and in somewhat of a journalistic and crusading attitude, is intended to explain Mendelism and the physiology of reproduction, with especial reference to farm animals. For those already moderately informed in this field it is a bit superficial and superfluous. Mistakes are fairly frequent; but most of these concern details rather than important general principles. Examples are the implications regarding the practical importance of linkage (p. 18, etc.), the almost complete acceptance of the electrolytic separation of male-producing and female-producing sperms as a fact (p. 71), remarks about the frequency of functional hermaphroditism in poultry (p. 83), and the extreme emphasis on the unsuitability of breed crosses for further breeding use (p. 112).

Probably nowhere else can the city-reared get so much information in this field for as little as a shilling. If its lively and interesting style inspires readers to learn more about the subject from more accurate sources, its net effect will be good. If its readers stop with this they will have been entertained and the city-reared among them will have been enlightened and slightly confused about some of the details but they will only have started to learn about animal breeding.

J. L. LUSH



THE BULL TERRIER: A Comprehensive Treatise on the History, Management, Breeding, Training, Care, Showing and Judging.

By E. S. Montgomery. *Orange Judd Publishing Company, New York.* \$3.50. 415 pp.; ill. 1946.

This is a readable exposition on dogs in general, and the Bull Terrier in particular. Many historical details about the breed are given. Dog-lovers should enjoy it. The author, a physician, presents his story with enthusiasm. In his own words, "This book records facts about the Bull Terrier which the author has collected over a period of twenty years. It includes many methods employed by the author in his breeding kennels, also information gathered from conversation with breeders, judges, and exhibitors, as well as experiences gained from dogs of all breeds—but especially from Bull Terriers."

W. A. CRAFT

BREEDING THOROUGHBREDS.

By Colonel John F. Wall. *Charles Scribner's Sons, New York and London.* \$3.75. xx + 180 pp. + 1 chart; ill. 1946.

Colonel Wall writes as one who loves Thoroughbreds. This book contains much information regarding pedigrees, families, and noted animals. It contains also information of historical interest in respect to the Thoroughbred horse. Sections relating to the science of breeding are brief but presented in a manner to aid the novice.

W. A. CRAFT



ANIMAL MORPHOLOGY

TRATTATO DI ISTOLOGIA. Third Edition.

By Giuseppe Levi. *Unione Tipografico-Editrice Torinese, Torino, Italy.* Lire 3600 (paper). xvi + 1132 pp.; ill. 1946.

The third edition of Levi's *Trattato di Istologia*, prepared and issued under what must have been extremely trying conditions, is a splendid monument to the scholarship and diligence of its author, as well as to the determination and skill of the *Tipografia Sociale Torinese*. Several sections of the book have been considerably revised and amplified beyond their scope in previous editions—notably the section on chromosome cytology. In these days when our own textbooks of this much-maltreated subject seem to be contracting, edition by edition, to dry unsupported statements and meagre outlines of just as much as a rather lazy student might be expected to retain after exposure to a semester course, it is a pleasure to hold in one's hands a treatise composed in the leisurely manner, with adequate discussion of sources, and illustrated more than generously with handsome figures, many of them original.

Even so large a work must have its viewpoint and its limitations. The book is directed to the medical student, and the emphasis naturally is on human and mammalian material. Much is cited from other animal and plant forms, by way of illustrating principles; but no attempt has been made to carry through a systematic comparative approach. On the other hand, mammalian Histology, as viewed by Giuseppe Levi, is not Microscopic Anatomy. The student will find that the first major section of the book (Second Part: ca. 200 pp.) is devoted to pure Cytology—that is, to cell structure as related to cellular biology; and that only in the Third Part are tissues discussed. These are not at all considered in relation to the architecture of organs, but are abstracted, analytically, from their situation in the body. A completely logical order of presentation is in such a case out of the question. Levi compromises by using a plan partly developmental: e.g., epithelia and epithelial derivatives; partly functional: tissues with mechanical function, trophic tissues, etc. It is inevit-

able that predilection in the choice of material, due to the author's own researches, should likewise predominate in his treatise: nervous tissue (including supporting elements) occupies some 200 pages in this section.

Revised during the war years, and long delayed in printing, the book quite understandably lacks much of the wartime and post-wartime work. What is surprising is that so much current material really has been included, even though much of it is in the form of added paragraphs or appended notes. The last few years have seen striking advances in our understanding of the biochemical mechanisms of certain of the structures and tissues dealt with; perhaps in these cases a radically new orientation would be desirable. Pervaded as we are at the moment by the new histochemistry (much of it not so very new) and cellular biochemistry, it is, however, well to reflect that considerable time must elapse before any coherent body of cell and tissue chemistry can adequately replace classical histology in scope and in biological applicability. Levi does us a great service in reminding us, in the midst of our excitement over new methods and new results, of the vast heritage of morphological and experimental-morphological information and problems left us by the past hundred years.

To return to the original purpose of the book: the fact of its publication at this time, and its handsome format, combine to reassure us that the new generation of the Italian medical profession will continue to be influenced, in their views on cellular and tissue biology, by a teacher who, in addition to being a scholarly morphologist and a confirmed experimentalist, has consistently enlarged his sources and his outlook beyond national or continental boundaries.

DOROTHEA RUDNICK



MICROSCOPIC ANATOMY OF VERTEBRATES. *Third Edition.*

By James I. Kendall. Lea & Febiger, Philadelphia. \$6.00. 354 pp.; ill. 1947.

In the words of the author's preface, this book is designed "to supply a working knowledge of vertebrate microscopic anatomy, based on selected representatives of the various classes, to supplement courses in comparative anatomy and embryology, and to provide a foundation for physiology and graduate work. . . . It is intended to avoid undue emphasis on human or mammalian material since this field is covered by a number of excellent histological texts prepared especially for medical and graduate students."

As an introduction to classical, fixed-and-stained, low-power histology, this is an adequate text. It is hardly calculated to give the student any real idea of modern trends in histology and of the increasingly important role of histochemical and cytochemical meth-

ods. It does not seem that to ask this should be too much, even of an introductory text.

WILLIAM L. STRAUS, JR.



HANDBOOK OF MICROSCOPIC CHARACTERISTICS OF TISSUES AND ORGANS. *Third Edition.*

By Karl A. Stiles, with an introduction by Melvin H. Knisely. The Blakiston Company, Philadelphia and Toronto. \$1.75 (paper). x + 214 pp.; ill. 1946; 1948.

This reprinting of the third edition (see Q. R. B. 22: 162. 1947) has admirably corrected the account of mitosis criticized in our review.



STEREOSCOPIC ATLAS OF NEUROANATOMY.

By H. S. Rubinstein and C. L. Davis. Grune & Stratton, New York. \$10.00. 19 pp. + 43 plates. 1947.

This atlas comprises 43 plates of stereoscopic photographs, each of which is accompanied by a labelled line sketch, illustrating "those brain structures which have been found useful by the authors in the teaching of neuroanatomy." The spinal cord is not included. The first 5 plates deal with gross embryology, the remaining 38 with the undissected and dissected adult brain. A dissection manual, outlining the procedure followed in the preparation of the plates, is included.



AN ATLAS OF ANATOMY FOR ARTISTS. *First American Edition from the Sixth Revised Edition.*

By Fritz Schider. Revised by M. Auerbach, with contributions by Franz v. Stuck. Translated by Bernard Wolf. Dover Publications, New York. \$6.00. xxviii + 116 plates. 1947.

Anatomical atlases for artists have recently appeared in increasing numbers but without real improvement in the all-important selection of information needed by artists. The present volume contains very little text, barely enough to explain the generous supply of illustrations. The latter are accurate and adequately reproduced, but include a good deal that is of no use to artists. For instance, the crude Frontal Sections through the Head and through the Pelvis of a Seven Months Old Foetus, or the distorted Cross-Section through the Abdomen are by themselves of no help or interest to any artist. On the other hand, more than one single and schematic drawing of facial muscles would seem most desirable. The ghastly photographs of Female Anatomy, showing contours and proportions, must have been selected by a misogynist. This book

risers above mediocrity by the inclusion of some splendid drawings of human figures by the late German painter Franz von Stuck.

A. H. SCHULTZ



DAVISON'S MAMMALIAN ANATOMY with *Special Reference to the Cat*. Seventh Edition.

Revised by Frank A. Stromsten. The Blakiston Company, Philadelphia and Toronto. \$4.25. xii + 349 pp.; ill. 1947.

Among the special mammalian anatomies, this is one of the best known, and it is widely used in courses in comparative anatomy where the cat is the particular object of dissection. In general, it is a concise, useful book, but at the same time it is possessed of many of those defects common to most textbooks of vertebrate comparative anatomy.

Actually, it is a cat anatomy, with some limited attempts at comparison with other mammals, notably man. The author gives evidence of being aware that the future of comparative anatomy, if it is not to remain moribund, lies in a reorientation to a more physiological viewpoint. Thus he has stressed the adaptational aspect of his subject, which is all to the good, and in this respect the book contrasts markedly with many other current textbooks. It includes a brief comparison of mammalian limb structures from a functional aspect, a short consideration of muscular adaptations, one page devoted to a wholly inadequate account of the functions of the cerebral cortex; and occasional references to physiology are scattered through the text. But the author has not taken full advantage of his opportunity. For example, in the last few decades the nervous system of the cat, and more particularly the brain, has been the object of such extensive and intensive study that a stimulating account of encephalic function could have been included. Until the practitioners of comparative anatomy realize that this branch of science is legitimately comparative *biology*, and not merely descriptive, dead-house morphology, and that comparative physiology should be an integral part of comparative anatomy and not merely window-dressing, their subject will continue to wither on the stem. If comparative anatomy is now virtually passé, as many biologists insist, the fault is that of comparative anatomists themselves and not of the lack of problems worthy of consideration.

It is rather appalling to find so many errors or questionable statements and omissions in a seventh edition. A few, selected at random, follow: Neither the neurilemma nor the node of Ranvier is present in the mammalian central nervous system (p. 23). One may question the implied difference between "muscle tone" and "nervous tone" (p. 96). It is grossly misleading to describe the walls of the pulmonary air sacs as "somewhat like the peritoneum" (p. 242). It is not helpful to the

student to present the nervous system as divided into central, peripheral, and autonomic components (p. 239). The term "cerebrum" includes more than the frontal, parietal, occipital, and temporal lobes and, furthermore, it is not "primarily a mammalian structure" (p. 261). There are not "seven" cranial nerves originating from the mammalian medulla (p. 275). Not all spinal nerves possess "two" rami communicantes (pp. 281, 297). The superior cervical ganglion does not give off parasympathetic fibers (pp. 286, 289). The accessory nerve is composed of more than the spinal portion (pp. 289, 291). In discussing sense organs, no mention is made of either muscle spindles or tendon organs (p. 302). The only muscles for which the innervation is given are the extensor muscles of the shank (p. 121). The joints are inadequately treated, receiving scarcely more than two pages of text. Inclusion of the endocrine organs with the vascular system is grossly misleading; and the references to their function would have been better omitted. It may be interesting, but hardly enlightening, to learn that "without thyroid, no thought, no growth, no distinct humanity or animality is possible" (p. 229), that "the adrenal gland (medullary portion) is the gland of masculinity . . ." (p. 230), and that insulin "aids in the conversion of glucose into glycogen . . ." (p. 233).

Many of the titles in the lists of literature are incorrect, not infrequently being paraphrastic; this is hardly calculated to foster respect for bibliographic care in the student. The inclusion of so many figures illustrating the anatomy of mammals other than the cat, rather than figures of feline anatomy, is at least open to question.

WILLIAM L. STRAUS, JR.



SQUINT AND CONVERGENCE: *A Study in Di-o-phthal-mology*.

By N. A. Stutterheim. H. K. Lewis & Company, London. 15s. viii + 95 pp. + 1 plate; text ill. 1946.

In this interesting book Stutterheim purports to show "squint in a new light." However, when the material in the book is carefully analysed, it is found that the problem of squint has not been presented in a new light at all, but instead old ideas on squint have been presented in a new terminology. In general, the terminology employed obscures rather than clarifies the development of the ideas presented. Because Stutterheim has assigned new meanings to old words, he has introduced unnecessary confusions which make it difficult to follow his thoughts. With this lack of clarity it is doubtful that the book will have much influence on the general current of thought concerning squint. This may be unfortunate, for although the book presents no new ideas, it does summarize many of the reasons that have led to the formation of the so-called neurogenic theory of the etiology of strabismus.

Stutterheim points out that in the higher mammals the two eyes, each perfect sensory organs in themselves, have been united into a single sensory organ by fusion. He states: "It is, I believe, a unique condition in biology that two perfect organs of sense, the right and the left eye, should together become a new—namely, a higher—sense organ of the same modality through the sensory unification of the foveal impressions by kinetic reflex activity." The kinetic reflex activity which produces the sensory unification Stutterheim calls "convergence," whereas most authors use the more general term "fusional movements" of the eyes. The term "convergence" as used by Stutterheim is very restricted. He states that what most authors call convergence is composed of two components: one, a voluntary component which he calls "binocular adduction," and the other, an involuntary, which he calls "convergence." He reemphasizes the idea that squint results when the two separate eyes fail to become integrated into a single functioning unit. He says that "squint is a physiological brain disorder of the integrative action for the bi-foveal eye," and that in squint there "is insufficiency or lack of effective power of involuntary or reflex convergence, which is the basic movement of the bifoveal eye." When the integration of the two eyes fails, confusion and diplopia result and the more primitive force of voluntary adduction is used to place the false image on a peripheral portion of the retina where it can be less easily seen. At a later stage, voluntary adduction is replaced by a tonic reflex to maintain the habitual posture, and still later by anatomical changes in the fascial connections of the muscles.

Stutterheim concludes that the logical therapy for strabismus is to increase the effective power of the involuntary or reflex convergence. He accomplishes this by using a battery of prisms to elicit convergence movements. When the progress becomes stationary after this treatment he uses operations (called "surgical adjustments") to correct those anatomical changes that have resulted from the habitual position of the eyes. Of 97 patients treated with these methods, Stutterheim claims to have obtained "excellent" results in 92, an almost incredible percentage of cures.

W. C. OWENS



THE HUMAN EAR in Anatomical Transparencies.

By Stephen L. Polyak, Gladys McHugh, and Delbert K. Judd. Sonotone Corporation, Elmsford, New York; T. H. McKenna, New York. \$10.50. viii + 136 pp. + 3 plates + 20 transparencies; text ill. 1946.

Although published under different auspices, this remarkable book is a fitting companion to *The Human Eye in Anatomical Transparencies*, by Kronfeld, Polyak, and McHugh (1945). Like that on the eye, it is founded upon a series of magnificent colored paintings by Gladys McHugh. In all, there are 83 figures, includ-

ing not only series of transparencies but also numerous separate color plates and black-and-white drawings. These are accompanied by an excellent, detailed text. Each of the two parts of the book—Gross Anatomy of the Auditory Apparatus and of the Organs of Speech, and Structure and Function of the Middle and the Inner Ear—contains a series of transparencies showing, respectively, the whole auditory system in relation to the head (actual size) and the middle and the inner ear (three times actual size). There are keys to the illustrations, an extensive bibliography, and an index. The entire format of the book is of extremely high quality.

The authors are to be congratulated for a truly noteworthy accomplishment.

WILLIAM L. STRAUS, JR.



CRANIAL CAPACITIES, A STUDY IN METHODS. *Fieldiana, Anthropology*; Volume 36, Number 3.

By Wilfrid D. Hambly. Chicago Natural History Museum, Chicago. 75 cents (paper). Pp. 25–75. 1947.

The volume of the brain cavity of the human skull is of great anthropological interest, but its exact determination is a laborious task. Various formulas have been devised for quick, empirical estimation of the cranial capacity, based upon the main cranial diameters. In this study there have been conveniently assembled the averages for cranial capacities in great many series of adult human skulls of different ethnic groups, and directly measured values are contrasted with calculated results. The average capacities of males range from 1256 cc. in Tasmanians to 1488 cc. in some European series. The average capacities of women are anywhere from 7 to 13 per cent smaller than the averages of men of corresponding groups. Generally speaking, the formula of Isserlis ($.0003849 \times BLH + 96 \pm 65/\sqrt{N}$) with some slight amendments yields calculated values which agree most closely with the results of direct determinations.

A. H. SCHULTZ



ANIMAL GROWTH AND DEVELOPMENT

EXPERIMENTAL EMBRYOLOGY IN THE NETHERLANDS, 1940–1945. *Monographs on the Progress of Research in Holland During the War*.

By M. W. Woerdeman and Chr. P. Raven. Elsevier Publishing Company, New York, Amsterdam. \$2.50 (paper). xii + 132 pp.; ill. 1946.

This small monograph, the preface to which is dated on V.E. day, describes the work carried out in experimental embryology at the Universities of Amsterdam and Utrecht during the years of German occupation.

It is slight in size, but far otherwise in content and import.

It presents the results of 28 investigations by 17 workers, one of whom, J. Kloos of the University of Utrecht, was shot by the Nazis in January, 1945. The details of these studies cannot be enumerated in a brief review. The investigations, some of which were concerned with morphological, others with chemical aspects of development, dealt with amphibian and chick material, and with the development of *Limnaea stagnalis*. The most noteworthy of the contributions in experimental morphology seem to the reviewer to be the following: Studies on the determination of the polarity of the ectoderm, showing that the polarity of the ciliary beat in the epithelium of the ependyma and the auditory vesicles is determined at a different time than, and independently of, the axes of the vesicle and the neural plate (M. W. Woerdeman); studies on the development of teeth formed of ectoderm of *Triton* and mesoderm of *Amblystoma*, demonstrating that the size of the chimeric teeth is dependent upon the size of the enamel-organ (M. W. Woerdeman); experimental studies on the development of the pronephros, confirming the fact that the pronephric duct does not grow backwards from the pronephros but develops in situ from the lateral plate (J. H. M. G. Van Deth); studies describing the influences of trivalent arsenic and carcinogenic hydrocarbons on amphibian development (G. Ten Cate); investigation of the comparative inductive powers of medial and lateral parts of the archenteric roof (C. P. Raven and J. Kloos); studies on the development of the pineal organ (J. C. Van de Kamer). In addition, the chemical studies on the amphibian egg begun by Ten Cate at Amsterdam, and the exhaustive study on the egg of *Limnaea stagnalis* undertaken at Utrecht, deserve special mention.

It is not possible to review this book without mentioning the conditions under which the investigations were done. In reporting Ten Cate's results, Woerdeman had, for instance, to state: "Ten Cate started work with great diligence, but the unfavourable times have hindered him very much in his work. All kinds of apparatus, simple glassware, chemicals were soon no more available, and finally work became quite impossible when electric current and the gas supply failed. Still it is possible to make some mention of Ten Cate's work." Pure science is pure science indeed, but what scientist can ever forget that these investigators are not only scientists but also men of honor and courage, and who of us can fail to be moved by the eloquence of Woerdeman's quiet comment concerning his own researches: "They will have to be continued no sooner external circumstances permit and the mental peace required for experimental research will have returned?"

The Editors of the Monograph Series of which this forms a part, in their Foreword, "express their greatest admiration for the publishing house of Elsevier, which took very serious risk in preparing this series in war-

time, when all activity on behalf of such international purposes was strictly forbidden." It is relevant to add that the execution and reproduction of the magnificent illustrations, the excellence of the paper and the beauty of the typography far surpass those of our own peacetime productions, and add new lustre to a name ancient and distinguished in publishing fame.

JANE OPPENHEIMER



CORRÉLATIONS HYPOPHYSO-ENDOCRINES CHEZ LE TRITON: *Déterminisme Hormonal des Caractères Sexuels Secondaires. Histophysiologie, Volume IX. Actualités Scientifiques et Industrielles*, 987.

By H. Tuchmann-Duplessis. Hermann et Cie., Paris. 300 fr. (paper). 199 pp. + 7 plates; text ill. 1945.

The amphibians are excellent objects for a study of hormonal correlations. Much work has been done in this field, but few papers contribute such a wealth of histological detail as this monograph. The first part deals with the histology of the pituitary gland in *Triton*. Chromophobe, eosinophile, and basophile cells are distinguished, and a secretory cycle can be detected in each of these cells. The secretory cycle corresponds to seasonal variations in the development of secondary sex characteristics. The second part of the book is a report on the effects of hypophysectomy upon the gonads, thyroid, and adrenal glands. The gonads of both sexes and the adrenals show a rapid response to hypophysectomy. Whereas testes, ovaries, and adrenals show signs of involution within a few days after removal of the pituitary gland, the thyroid is much less affected. The third part of the monograph is concerned with the secondary sex characteristics in relation to the reproductive cycle. Both the appearance in gross and under the microscope are described in detail. The effects of castration and of parental administration of testosterone propionate or of gonadotrophic hormones on the secondary sex characteristics of the castrate male *Triton* and on males during the period of sexual inactivity were studied. In the castrate, substitution therapy with testosterone was successful, in so far as the secondary sex characteristics were concerned. Testosterone stimulates the growth of the crest of *Triton* during the resting stage. This has been known for some time. The author apparently has overlooked the paper by Fleischmann and Kann, who were the first to describe this effect (1936). The gonadotrophic preparation from horse's serum proved ineffective both in castrated and normal animals.

The histology and cytology recounted in Tuchmann-Duplessis' work are outstanding. The techniques of fixation and staining are carefully described, and the findings are documented by excellent drawings and microphotographs. The bibliography is extensive, though one of the most important papers in the field,

that of Bresca, though mentioned in the text, has been omitted from the bibliography. The book is warmly recommended to students of comparative endocrinology.

WALTER FLEISCHMANN



GESTATION PERIODS: *A Table and Bibliography. Technical Communication Number 5. Second Edition.*

Compiled by J. H. Kenneth. Imperial Bureau of Animal Breeding and Genetics, Edinburgh; Imperial Agricultural Bureaux, Penglais, Aberystwyth. 3s. (paper). 30 pp. 1947.

In this new edition numerous records, including those for 35 additional species, have been inserted, and one hundred references have been added to the bibliography. In the reference list, the authors are arranged in alphabetical order, 442 papers being included. In addition to the numerous species listed, hybrids and domestic breeds are also included wherever information has been available. This is an invaluable reference list for anyone working in the field of mammalian reproduction.



TEXTBOOK OF EMBRYOLOGY. *Fifth Edition.*

By Harvey Ernest Jordan, and James Ernest Kindred. D. Appleton-Century Company, New York and London. \$7.50. xvi + 613 pp. + 2 charts; ill. 1948.

This new edition has a number of revisions and additions of material which make it an improvement over previous editions. This is particularly true of the chapters on the early development of the human embryo. Unfortunately, as much cannot be said for those sections of the book in which gastrulation, and primitive streak and chorda-mesoderm formation in birds are described. The account given does not represent a forgivable five- or ten-year lag behind the advance of knowledge, but in certain respects is almost archaic. For example, the theory of concrescence of the lateral halves of the dorsal, blastoporal lip to form the primitive streak—"the heresy of concrescence" as Richard Assheton called it in 1916—continues to be perpetuated in spite of its disproof many years ago. The account of endoderm formation in birds is one which was effectively criticized by Assheton in 1912 and has received no support from any source since that time. The description of mesoderm and notochord formation is likewise erroneous in the light of observations and experiments carried out by embryologists in Germany, France, and this country during the last twenty years. It is indeed unfortunate for the value of the book as a whole that the account of the early developmental processes is such a poor reflection of our present knowledge of these processes.

N. T. SPRATT, JR.

A LABORATORY MANUAL OF COMPARATIVE VERTEBRATE EMBRYOLOGY.

By Allyn J. Waterman. Henry Holt and Company, New York. \$3.50. viii + 248 pp. + 54 plates. 1948.

A wealth of information which promises to be very useful to the beginning student of comparative vertebrate embryology is to be found in this compact laboratory manual. Indeed, so many of the background data are included with each exercise that the book may be more correctly described as a combination textbook-laboratory manual or handbook than simply as a laboratory manual. Tabular, comparative summaries of practical information concerning gestation periods, estrus cycles, reproductive periods, sperm and egg viability, etc., are interspersed throughout the book.

The general plan of treatment of the material of the first nine chapters (i.e., through gastrulation and chorda-mesoderm formation) is comparative. The remainder of the book, which is concerned mainly with the development of body form, histogenesis, and organogenesis, does not follow this plan. These later phases of embryology are described first for the frog, then for the fish, chick, pig, and rabbit. Although the general plan here is not comparative, the author frequently points out comparisons between corresponding stages of the different types. A number of demonstrations are suggested to keep the comparative point of view before the student.

A few minor errors, hardly avoidable in a book covering such a wide field of information, occur in the textual parts. For example, the primitive streak of birds is described as shortening without any backward migration of the node. None of the available experimental evidence supports this view. The author, however, has in general presented the evidence on both sides of the argument over the still unfortunately large number of debatable concepts in comparative embryology. That is commendable.

The illustrations at the back of the book are on the whole very satisfactory, but a few of the photographs are not as clear as one might wish. There is also an unfortunate inversion of the photographs of sections of the 72-hour chick with respect to the comparable sections of the 48-hour chick and 10-mm. pig. These minor points, however, do not detract from the interesting style in which the material is presented nor from the utility of the manual.

N. T. SPRATT, JR.



A WORK-TEXT ON HUMAN EMBRYOLOGY.

By Kenneth M. Richter. University of Oklahoma School of Medicine, Oklahoma City. \$4.50 (paper). 162 pp. + 16 plates. 1945.

This book consists of 178 pages planographed on one side of each page, with the facing page left blank for

notes and drawings. The last sixteen pages consist of plates illustrating human embryos of the University of Oklahoma collection. These are line drawings of serial cross sections and photographs of reconstructions of a 2.1 mm., a 3.6 mm., and a 5 mm. embryo. The last three plates are photographs of reconstructions of a 9 mm., a 13 mm., and a 23 mm. embryo.

Enlarged drawings of sections, or of parts of sections, of these and older embryos are found throughout the book, averaging exactly one figure per page for the 158 pages of the text. The text drawings are unlabeled and have lead-lines to the structures which the students are to study and label. Word descriptions are reduced to a minimum, as may be inferred from the fact that figures and laboratory directions occupy about half of the book. There is a Table of Contents, but no Index.

This book was written for a specific course in human embryology and for a specific collection of sectioned human embryos. The extent to which it will be found useful in other institutions will depend upon the extent to which other professors will wish to modify the laboratory instructions to suit their own needs and their own embryological material.

JAMES A. MILLER



THE ORIGIN AND DIFFERENTIATION OF THE LARVAL HEAD MUSCULATURE OF *TRITURUS TOROSUS* (RATHKE). *University of California Publications in Zoology, Volume 51, Number 3.*

By Arthur G. Rempel. *University of California Press, Berkeley and Los Angeles.* 50 cents (paper). iv + pp. 87-128; ill. 1943.

AN EXPERIMENTAL STUDY OF THE HISTOLOGICAL AND FUNCTIONAL DIFFERENTIATION OF THE EPITHELIAL HYPOPHYSIS IN *HYLA REGILLA*. *University of California Publications in Zoology, Volume 51, Number 7.*

By Arthur B. Burch. *University of California Press, Berkeley and Los Angeles.* 50 cents (paper). ii + pp. 185-214; ill. 1946.

PHYSIOLOGY AND PATHOLOGY OF THE NEWBORN. *Bibliography of Material for the Period 1930-1940. Monographs of the Society for Research in Child Development, Volume X, Serial Number 41, Number 2, 1945.*

Compiled by A. N. Antonov. *Society for Research in Child Development, National Research Council, Washington, D. C.* \$2.50 (paper). ix + 217 pp. 1947.



ANIMAL PHYSIOLOGY

HANDBOOK OF PHYSIOLOGY AND BIOCHEMISTRY. Originally "Kirkes" and later "Halliburton's." *Thirty-ninth Edition.*

By R. J. S. McDowall. *The Blakiston Company, Philadelphia.* \$7.00. xii + 898 pp. + 10 plates; text ill. 1946.

The 39th edition of this standard textbook bears a date just 98 years later than that of the first edition, prepared by Wm. S. Kirkes. This fact is enough to show that a consistent effort has been made through the years to keep it up to date. It is, of course, essentially a treatment of human, or mammalian, physiology, having been planned and written as a textbook for medical students. With time it has unavoidably increased in size, particularly since, ten years ago, biochemistry was recognized as an integral portion of its subject matter. In the present edition the space devoted to histology has been drastically curtailed, since it was felt that an adequate presentation of that subject would require an entire book and that in the present connection histology should be limited to a relation of structure to function.



RECENT ADVANCES IN ENDOCRINOLOGY. *Sixth Edition.*

By A. T. Cameron. *The Blakiston Company, Philadelphia and Toronto.* \$6.00. viii + 443 pp. + 3 plates; text ill. 1947.

Although the proper title of this book should be "Recent Advances in Medical (or Clinical) Endocrinology," it will fill a useful place on the biologist's reference shelf. The new edition presents only slight changes. The chief additions are accounts of: The production of artificial iodo-proteins on a commercial scale; the use of thiouracil in treating hyperthyroidism, and the existence of individual differences in its toxic effects; and the successful treatment of a patient with Addison's disease over an 11-year period, with a return to almost complete normality, by means of implants and oral doses of desoxycorticosterone acetate plus weekly injections of cortin. The lists of references placed at the ends of the chapters have been brought up to date.



THE PHYSICAL BACKGROUND OF PERCEPTION. *Being the Waynflete Lectures delivered in the College of St. Mary Magdalen, Oxford, in Hilary term 1946.*

By E. D. Adrian. *Oxford University Press, London and New York.* \$3.25. ix + 95 pp. + 2 plates; text ill. 1947.

Every once in a while, the great scientists of our time should be encouraged to step out of their laboratories and to paint in broad, imaginative strokes the full picture of their endeavors. Such an opportunity arose when E. D. Adrian was invited to present the Waynflete Lectures at Oxford in 1946. His six lectures are the substance of this little book.

"What," asks Adrian, "has the physiologist been able to tell us about the workings of the brain and the mind? How do we perceive things?" His answer is this review of the present state of our knowledge in the fields of nerve and brain physiology. And yet it is

more than a review, because the author also speculates aloud about the meaning of certain puzzling findings in this area. He has taken time to worry aloud, as it were, about some things we don't know. This is not the sort of thing one can ever find in a scientific article.

To the neurologist and nerve physiologist, this book will seem quite elementary. But it should be most stimulating to the biologist who is acquainted with this field only in general terms. It is a delightful little book, well-written, easily comprehensible, and uncluttered with footnotes, references, and other scholarly accouterments. I recommend it highly for an hour's worth of genuine reading pleasure.

A. CHAPANIS



RESEARCHES ON NORMAL AND DEFECTIVE COLOUR VISION.

By W. D. Wright, with a foreword by L. C. Martin.
The C. V. Mosby Company, St. Louis. \$10.00. xvi
+ 383 pp. + 1 chart; text ill. 1947.

W. D. Wright needs no introduction to research workers in the field of vision. During the last twenty years, his studies of the luminosity, color mixture, discrimination, and adaptation functions in normal and defective color vision have been characterized by their thoroughness and precision. The results of his researches are, in some cases, the standard data to which other visual scientists continually refer. In short, there is probably no one better qualified to write on the subject of color vision.

This book is essentially a summary and review of the author's work in the field. Although the work of other scientists has not been completely ignored, for the most part this is a complete record of Wright's own investigations. Ordinarily, one might expect such a book to be completely unbalanced. There are, to be sure, some rather obvious deficiencies in it. Spatial and temporal contrast, chromaticity as a function of brightness, color perception, tests of color blindness—all these topics, and many more, receive cursory treatment, if they are mentioned at all. But Wright's interests in the field have been so broad that, in writing about his own work, he has given us the best single text on color vision available at the present time.

The author's style is lucid throughout, despite the difficulty of most of the material. His discussion of color equations, unit trichromatic equations, and chromaticity diagrams, for example, is one of the clearest the reviewer has ever read. The book is, nonetheless, an advanced and highly technical work. It will probably be suitable as a text only for advanced seminars in vision. For the physicist, physiologist, or psychologist interested in color vision, however, it is required reading.

A. CHAPANIS

MATHEMATICAL ANALYSIS OF BINOCULAR VISION.

By Rudolf K. Luneburg. Published for the Dartmouth Eye Institute by Princeton University Press, Princeton. \$2.50 (paper). vi + 104 pp.; ill. 1947.

Experiments on visual space perception have occasionally yielded some very puzzling data. Ames, for example, at one time constructed a series of rooms with curved walls and windows. When the curvatures were properly selected, all the rooms appeared to have the same rectangular form. In short, a great variety of different physical stimuli resulted in the same perceptual experience. Still other experiments show that the apparent localization of a surface can be changed perceptually by drawing various geometrical patterns on the surface.

The author's aim in this monograph is "to develop a mathematical theory of visual perception" which can account for phenomena of this sort. It is a limited theory, since it is concerned only with the binocular perception of visual space. In particular, the author has tried to develop mathematically a three-dimensional, geometric representation of the loci of points in physical space which appear to be equidistant in binocular vision.

This is the kind of work which should be read by psychologists, physiologists, and physicists who are concerned with visual phenomena. But it won't be! Even to someone with a more than average amount of mathematical sophistication, this is a pedantic, confusing, and extremely difficult treatise. It is most unfortunate that many scientists have not yet learned that scholarly writing is not necessarily incompatible with clear writing. The author doesn't state for whom he wrote the monograph, but one thing is clear—if the reader is not thoroughly conversant with non-Euclidian geometry and differential equations, he will do well to leave it alone. Meanwhile, we may hope that somebody will one day translate this work for ordinary visual scientists. It can be done, as Hogben has shown.

A. CHAPANIS



ANIMAL NUTRITION

NOT BY BREAD ALONE.

By Vilhjalmur Stefansson. The Macmillan Company, New York. \$3.50. xviii + 339 pp. 1946.

This is an interesting, and even at times amusing book, written by an active protagonist for a pure meat diet. Stefansson relates his experiences in the far north, where he lived on meat alone, and his subsequent adventures under observation in Bellevue Hospital while on a one year meat diet to convince the sceptical medical fraternity that men can live on meat alone and remain in optimum health.

A second theme of the book revolves around pemican as the best known balanced condensed food ration

ever devised by man. Here again the author is active protagonist and attacks especially those entrenched dieticians who during the past war rejected pemmican as completely unfit for use by troops. From Stefansson's presentation of the data, including a lengthy history of the use of pemmican and numerous testimonials as to its virtues, it is difficult to see just how the dietitians could have been right. One suspects, as Stefansson brings out, that many crimes are committed in the name of pemmican. The author shows very nicely that there has been an accidental perversion of the use of pemmican. It was originally a hot weather food, but because it was also suitable to cold weather work and was used by the arctic explorers, it has come to be thought of as a cold weather food only. This is in part tied up to the myth that fatty foods are unsuitable for hot weather consumption. These and many other myths concerning meat for food Stefansson explodes with data gathered from all over the world.

Stefansson is not a physiologist, nor is he in the broadest sense an anthropologist. Perhaps this is an advantage, in a way, for his thinking is little inhibited by the dogma of any discipline. He is an active advocate. His work needs therefore to be read with some reserve. It should nonetheless be read, and it is to the author's credit that it can be read with considerable pleasure.

GEORGE F. CARTER



BIOCHEMISTRY

BIOCHEMISTRY FOR MEDICAL STUDENTS. Fourth Edition.

By William Veale Thorpe. *The Williams & Wilkins Company, Baltimore.* \$5.00. viii + 496 pp. + 4 plates; text ill. 1947.

This popular textbook has now appeared in a fourth edition. The major revisions have involved a rewriting of sections on protein structure, coenzymes, flavoproteins, bile pigments, and wartime nutrition. The author has also included a new chapter on the use of isotopes. Nevertheless some relatively archaic material remains. One may cite as an example the statements (p. 115) that "nucleic acids, in fact, are almost certainly composed of four units, called mononucleotides" and "recent experiments suggest that *all* the phosphoric acid groups are doubly esterified with ribose." Most workers in the last few years have shied away from positive statements in these directions, and indeed, some leading English investigators state quite the opposite in regard to the phosphate esterification. Although the author has included a special chapter on tracer methods, he has missed opportunities to indicate how it has affected specific phases of our knowledge of intermediary metabolism. Relations between metabolites, presented as hypotheses still to be tested, have already been established. Thus, (p. 276) "serine might

also form glycine." It not only might but it often does (Shemin, 1946). However, this was demonstrated perhaps too late for inclusion in this text. On the other hand, the tracer evidence for phenylalanine as a precursor to tyrosine (Schoenheimer, 1940) is quite old, yet is not mentioned.

The book appears to the writer to be one of the better textbooks available for medical students. Its binding and quality of paper are superior to what has been available in recent years to continental publishers.

MARTIN D. KAMEN



AN INTRODUCTION TO BIOCHEMISTRY. Third Edition.

By William Robert Fearon. *Grune & Stratton, New York.* \$6.00. x + 569 pp. 1947.

The initial appearance of this admirable volume was welcomed by most teachers of biochemistry bedeviled by the necessity for finding an acceptable textbook as a basis for instruction. Now the third edition has been released. The qualities inherent in the first two editions are retained, while improvements have been introduced in revising practically all the chapters. A new chapter on "tissue chemistry" brings the book into better contact with important phases of modern biochemistry, such as respiratory enzyme action, the chemistry of metabolic cycles (Szent-György, Krebs), and mechanisms of energy exchange. The proliferation of isotopic methods is indicated naturally and has not been introduced either with fanfare or disparagement. However, the opportunity to introduce tracer evidence into the text (e.g., interconversion of specific amino acids) has not been seized in all instances. Here and there a few unhappy remarks will be found, particularly in regard to the later history of muscle biochemistry (p. 340)—e.g., a rather positive statement is made about "an aerobic contraction mechanism independent of the Meyerhof-Parnas cycle" and some tracer work in photosynthetic CO₂ assimilation is quoted incorrectly, assigning a molecular weight of 350 to a photosynthetic intermediate when the original article gave values well over 1000 (p. 343). However, there is little to quarrel with and much to praise.

All textbooks on biochemistry which fail to include its dynamic aspects, presented so well in a recent text by Baldwin, miss much of the spirit of modern biochemistry. A little more of this viewpoint would help the present book by Fearon. However, there are many textbooks which nothing could help. Fearon is to be commended for making available a textbook of such general excellence.

MARTIN D. KAMEN



PRACTICAL CHEMISTRY for Medical Students.

By William Klyne, with a foreword by G. F. Marrian.

A William Wood Book, The Williams & Wilkins Company, Baltimore. \$6.50. xvi + 460 pp. + 1 plate; text ill. 1946.

This textbook is written to provide pre-medical students with a broad, comprehensive training in all phases of chemistry at the elementary level. Most writers would blanch at the ambitious task the writer set himself—to cover the fundamentals of the scientific method, practical laboratory manipulations, general and physical chemistry, inorganic chemistry, and organic chemistry. It is a new experience to find a book which deals with "cause and effect," "evidence," "design of experiments," etc., on pp. 1-5, and with boring and fitting corks on p. 46. It is not surprising that the breadth of the subjects treated leads to some attenuation. Nevertheless, much solid material has been included in this book, particularly with regard to laboratory manipulations and tests, in many instances running far ahead of those found in most elementary textbooks. It seems that the author has been remarkably successful in expounding with clarity so many of the fundamental ideas in chemistry without losing sight of the laboratory.

Most of the material presented should have been covered in the last few years of high school and the first years of undergraduate study at the university. One thinks of pre-medical students as having had more than the equivalent of training represented by this book before entering medical school. However, it is possible that the residuum of chemical knowledge left in medical practitioners a few years out of medical school is not more extensive than may be found within the covers of this book, which appears more an outline than a textbook. The extreme brevity of presentation may result in hardship for many students unless amply supplemented by classroom instruction.

MARTIN D. KAMEN



COLLOID SCIENCE. *A Symposium.*

By E. K. Rideal, A. E. Alexander, D. D. Eley, P. Johnson, F. Eirich, R. F. Tuckett, J. H. Schulman, M. P. Perutz, G. S. Adair, G. B. B. M. Sutherland and R. R. Smith. *Chemical Publishing Company, Brooklyn.* \$6.00. x + 208 pp.; ill. 1947.

This small book of 188 pages of text has ten articles by ten different authors. It is based on a post-graduate course given at Cambridge University. Unfortunately, except for two of the papers, each author has contented himself with giving a very bare outline of his subject. A. E. Alexander used 53 pages and F. Eirich 37 pages to discuss their topics, "Surface Chemistry and Colloids" and "The Viscosity of Macro-molecules in Solution," respectively. This leaves 98 pages for the remaining eight papers. The result is a very uneven book, in which two papers are very complete and eight are bare outlines.

This book could be used to get a quick survey of the field of colloid science; it would certainly be unsatisfactory for any other use. The price seems abnormally high, even in these days of the inflated dollar.

I. FANKUCHEN



THE SYSTEMATIC IDENTIFICATION OF ORGANIC COMPOUNDS. *A Laboratory Manual. Third Edition.*

By Ralph L. Shriner and Reynold C. Fuson. *John Wiley & Sons, New York; Chapman & Hall, London.* \$4.00. x + 370 pp.; ill. 1948.

Rearrangement in the presentation of chapters in this new edition enhances the value of a book which has always been useful as a text for students and a reference for laboratory workers. The complete outline of experimental procedure for the identification of organic compounds is now put in its proper place, at the beginning of the text. Each chapter, corresponding to a step in the identification process, then follows in logical order. Within each chapter, the plan followed in earlier editions is retained with few changes. New procedures have been added to Chapter VI, and values in tables throughout the book have been brought up to date. Of especial value is the inclusion in the index of the melting and boiling points of all compounds listed in tables throughout the text.

V. G. DETHIER



NUCLEIC ACID. *Symposia of the Society for Experimental Biology, Number I.*

[Edited by J. F. Danielli and R. Brown.] *Cambridge, at the University Press; The Macmillan Company, New York.* \$8.50. viii + 290 pp. + 18 plates. 1947.

The early proposal by Levene concerning the tetranucleotide structure of ribo- and deoxyribonucleic acids served to stimulate and revitalize the widespread interest in nucleic acid chemistry. Although geneticists have long since recognized the importance of nucleic acids as constituents of the chromosomes, it was not until Stanley and his group demonstrated the presence of nucleic acid in the tobacco mosaic virus that widespread biological interest in the nucleic acids was revived. Since that time very marked and surprising physiological effects have been obtained with these compounds. The relationship and importance of these compounds in protein synthesis, chromosome structure, pneumococcus transformation, adaptive enzymes, neural function, etc., are now being actively investigated.

The widespread importance of these compounds and the more recent findings and postulations concerning their function is well covered in a series of recent papers presented at a Symposium of the Society for Experimental Biology, held at Cambridge University. In a

series of articles concerned with the chemistry of nucleic acids J. M. Gulland, B. Lythgoe, A. R. Todd, D. O. Jordan, and W. T. Astbury participated. The structure of the nucleic acids, as revealed by chemical and physical methods, and the synthesis of their corresponding nucleotides and nucleosides were discussed extensively. H. M. Kalckar presented in detail his recent findings concerning the role of phosphate in the biological synthesis of purines, and T. Caspersson discussed the relationship between nucleic acid and protein synthesis.

The remaining papers of the Symposium were concerned primarily with the detection, distribution, and function of the nucleic acids and nucleoproteins in biological systems. J. F. Danielli considered the current cytochemical techniques, and P. Dustin, Jr., the vital staining of nucleic acids in cells. J. N. Davidson discussed the distribution and ratios of the two types of nucleic acids in tissues, while M. Stacey covered the present information available on the nucleic acids and nucleoproteins of the bacteria. Two papers were presented which were concerned primarily with nerve cell metabolism and function under varying conditions of activity and regeneration. The first paper was presented by H. Hydn and the second by D. Bodian. Papers concerned with the relationship of nucleic acids and their derivatives to the growth and metabolism of neoplastic tissues were presented by L. D. Parsons, J. M. Gulland, and G. R. Barker, and by R. E. Stowell. Nucleic acids in the cell and embryo were discussed by J. Brachet. Three papers concerned primarily with the nucleic acids and the chromosomes were presented. The Action of Enzymes on Chromosomes, by D. G. Catcheside and B. Holmes, is concerned primarily with the action of thymonuclease. The Function of Deoxyribose-Nucleic Acid in the Cell Nucleus is discussed by E. Stedman and E. Stedman; and C. D. Darlington presents certain observations and speculations concerning the nucleic acids in chromosome organization and behavior. The final paper, by P. C. Koller, deals with the problem of experimental modification of the nucleic acid systems in the cell by treatment with chemical or physical agents.

The present series of papers emphasizes the underlying unity of numerous biological problems, a chemical unity which is now becoming clear through the studies concerned with the nucleic acids and their functions. The symposium volume will be of great value to workers in biological and chemical fields because it serves to bring together the numerous problems related to nucleic acid metabolism.

W. D. McELROY



AN INTRODUCTION TO CHEMISTRY: *A Textbook and Laboratory Manual. With Teacher's Guide.*

By Imo P. Baughman. W. B. Saunders Company,

Philadelphia and London. \$3.00. x + 315 pp.; ill. 1947.

This is an extremely abbreviated treatment of the field of chemistry, seemingly prepared for the nursing curriculum. The text is limited to 170 pages, to which are added 29 pages of tabular information as an appendix. The remainder of the book is occupied by laboratory directions and report sheets and by the index. Yet there is one feature of the book that biologists will applaud, and that is the inclusion of organic chemistry and biochemistry in the introductory course. If the entire treatment is skimpy, at least it blazes the way toward a chemistry course that would be truly an introduction to biology.

BENTLEY GLASS



MICROBIOLOGY

MICROBIAL ANTAGONISMS AND ANTIBIOTIC SUBSTANCES. *Second Edition.*

By Selman A. Waksman. *The Commonwealth Fund, New York; Geoffrey Cumberlege, Oxford University Press, London.* \$4.00. xiv + 415 pp. + 13 plates; text ill. 1947.

The first edition of this book was a thorough survey on microbial antagonism and antibiotic substances. The rapid accumulation of information and expansion of the uses of antibiotics thoroughly justified the new edition. This consists of fourteen chapters, which deal with many phases of the general subject of antibiotic substances and microbial antagonisms. Among the subjects covered is the microbiologic population of soil and water as well as of human and animal wastes. The author deals with relationships among microorganisms and painstakingly describes methods for the isolation and cultivation of antagonistic organisms.

In his discussion of the antagonists, the author takes up antagonists and antibiotic substances derived from three general groups of micro-organisms: namely, those from the Actinomycetes, those from other bacteria, and those from fungi. In addition, he has discussed animal forms as antagonists and the relationship between protozoa and bacteria. In this chapter he has also included a description of the protozoan theory of soil fertility as well as "microbiological equilibrium." In the following chapter the antagonistic relationships between microorganisms, viruses, and other non-specific pathogenic forms are considered.

The author next develops the subject of the chemical nature of antibiotic substances. This portion of the text contains an excellent review of the chemical nature of antibiotics and is complete up to the time of its writing. There follows an excellent discussion on the nature and mechanism of antibiotic action. In this chapter the author not only reviews what is known concerning the mode of action of antibiotics but also

presents data on bacterial adaptation, as well as the use of antibiotic substances in the differentiation of bacteria. Comments on many fundamental problems in microbiology are interjected.

The author then devotes two chapters to the use of antibiotic substances for disease control. One chapter deals with antibiotics as chemotherapeutic agents. This is a review of the more important published material dealing with the clinical uses of antibiotics. It is not a clinical monograph, and it is obvious that the author did not intend it to be one. The other of the two chapters deals with what is known concerning the microbiologic control of plant disease. The volume concludes with a chapter which the author chooses to call *The Outlook for the Future*. Here again the author calls to the notice of the reader many of the problems which this new field of science has opened. He discusses the problems which concern the microbiologist, the chemist, and the physiologist as well as those interested in the practical application of antibiotics in the control of disease.

This book should be on the "must" list of reading for the teacher, the graduate student, or anyone interested in the general subject of microbiology.

WALLACE E. HERRELL



GERM-FREE LIFE STUDIES. *Lobund Reports; A Publication from the Laboratories of Bacteriology, University of Notre Dame, Number 1.*

Edited by James A. Reyniers. University of Notre Dame, Notre Dame. \$1.50 (cloth); \$1.00 (paper). viii + 120 pp.; ill. 1946.

This publication contains two papers: Rearing germ-free albino rats, by James A. Reyniers, Philip C. Trexler, and Robert F. Ervin, pp. 1-84; and Germ-free life applied to nutrition studies, by James A. Reyniers, pp. 87-120.

The first paper gives details of the extremely specialized and complicated apparatus and techniques required for obtaining and rearing white rats (or other small animals) in the absence of bacteria. The animals are obtained initially by Caesarian section. Stress is laid on the germ-free diets required. Vitamin C is very desirable for germ-free albino rats, although not absolutely essential. With vitamin C, there is better growth and lower mortality (less than 5%). Without vitamin C, growth is slower and the mortality is about 55 per cent. The nature of the protein supplied is also of great importance. Germ-free rats show no external difference from normal rats, but the lymphatic system is underdeveloped histologically. Also the cecum is enlarged, and there seems to be a disturbance in the fat metabolism, at least on certain diets.

The second paper stresses the nutritional aspects of the germ-free life of rats, guinea pigs, and chickens. In general, germ-free animals do not utilize natural

diets well. Complete diets fed to germ-free chickens do not give as good a growth as when fed to normally reared chickens. In the mammals, there is a disturbed fat metabolism and underdevelopment or atrophy of the ovaries. Germ-free chickens show a prolonged clotting time of the blood. Some experiments were also done in which one or more species of bacteria were introduced into the intestinal tracts of the animals. When this was done, an alteration in the diet was usually found to be necessary.

It is impossible to summarize adequately this important publication in a limited space. Those who are interested in the effects produced in warm-blooded animals by the symbiotic presence (of absence) of bacteria in the gastrointestinal tract, should consult the original publication.

WALTER C. TOBIE



TRAVAUX DU LABORATOIRE DE MICROBIOLOGIE de la Faculté de Pharmacie de Nancy. Fascicule XV.

By Faculté de Pharmacie de Nancy. Société d'Impressions Typographiques, Nancy. Paper. 96 pp. + 2 plates. 1947.

Fascicule XIV (1945) of this publication, normally an annual, was reviewed in Q. R. B. 21: 203-4, 1946. The present issue contains a portrait and obituary of Ph. Lasseur, who founded the publication in 1928, and whose unfortunate death occurred on January 10, 1946.

Seven original papers by J.-G. Marchal et al., are given, and may be summarized as follows: The reducing power of several dissociated strains of bacteria on ammonium molybdate in a synthetic medium was determined. Data are given on the production of the rose-colored and the fluorescent pigments of *Bacillus roseus fluorescens* under different cultural conditions. Another study briefly gives some conditions affecting the growth of this organism. *Bacillus lactis niger* Gorini showed a distinct antagonistic action against *B. mycoides* on agar plates, but only a very feeble action in liquid media. Limited data are given on allelocatalysis in the development of various species of bacteria. The effects of ultra-violet radiation on various species are reported. Data are also given on the action of *Bacterium tumefaciens* on the growth of the plants *Opuntia vulgaris*, *O. chaguenensis*, and *Pelargonium zonale*.

It is to be regretted that the work presented in several of the papers is quite limited in scope, and does not lead to any very definite or clear-cut conclusions. This may be the result of difficult post-war working conditions encountered by the authors.

WALTER C. TOBIE



TEXTBOOK OF MICROBIOLOGY. Third Edition, Revised.

By Kenneth L. Burdon. The Macmillan Company,

New York. \$3.50. viii + 728 pp. + 1 chart; ill. 1947.

This is a very satisfactory textbook of medical and sanitary microbiology, rather than one of microbiology in the widest sense. Only a limited mention is made of the industrial applications of microorganisms, although there is a good treatment of the fundamental facts and theories of microbiology. Besides pathogenic bacteria, the pathogenic molds, viruses, and organisms of other groups receive adequate treatment. A number of well-chosen references (usually to journal articles) are given at the end of each chapter. These references should be of great value if they can be used to pry students away from exclusive reliance upon textbooks, and to develop willingness to seek for information in primary sources.

The book is written in a style that is simple and direct. The material is generally remarkably sound, and is brought well up to date, as for example in the sections dealing with sulfonamide drugs and antibiotics. In particular, there seem to be few if any of the irritating misconceptions which have been repeatedly disproved by specialists in the various fields involved, but which appear to be almost indestructible, owing to the fact that they are parroted from one textbook to another, achieving a sort of discreditable immortality.

However, a few faults and errors may be noted. The value of carbon tetrachloride for first aid to minor burns (p. 235) may well be doubted. It is not entirely correct to say (p. 241) that streptothricin is an antibiotic of low toxicity. Under tuberculosis, it would seem desirable to make at least passing mention of the use of the avirulent Calmette-Guerin strain (B.C.G.) in prophylaxis and of streptomycin in therapy. Nevertheless, these are but minor points, and as a moderately advanced medical text the work is to be recommended.

WALTER C. TOBIE



A TEXTBOOK OF BACTERIOLOGY. Fourth Edition.

By Thurman B. Rice. W. B. Saunders Company, Philadelphia and London. \$6.50. xii + 603 pp.; ill. 1947.

This is a text for medical students, to be used in conjunction with a course of lectures and laboratory exercises. The material presented has been rather solidly established, the idea being that very recent advances can be presented in the lectures, which may be revised from year to year as conceptions change. Relatively little attention is paid to non-medical bacteriology. However, disease-producing microorganisms other than bacteria (viruses, rickettsiae, protozoa, pathogenic fungi, yeasts, and the like) receive very adequate treatment. There are also several excellent chapters on immunology, serology, hypersensitiveness, and related topics. The book is written in an interesting style without any observable sacrifice of accuracy. Besides

being a very satisfactory textbook for medical students, it should be valuable for microbiologists who have occasional need for a condensed but authoritative presentation of material outside of their own special fields. One minor but helpful feature is the brief characterization of organisms such as the "Boas-Oppler" and the "Zur Nedden" bacilli, which are occasionally mentioned in the clinical literature, but which are little known to most theoretical bacteriologists.

Even the best of books contains some errors, and the present work is no exception. Thus, on p. 287 it is not quite correct to state that "not one member of the armed forces of the United States and Great Britain in World War II died of tetanus." It is true that tetanus was extremely rare, but nevertheless a few fatal cases did occur even in previously immunized personnel (cf. J. S. K. Boyd, *Lancet* 250: 113-19. 1946). The structural formula for sulfamerazine (p. 539) is incorrect, being the same as that given for sulfadiazine. Furthermore, the oral use of penicillin has been quite firmly established, despite the statement (p. 561) that efforts to make it absorbable by mouth have met with little success. These are minor points, and on the whole the book may be highly recommended.

WALTER C. TOBIE



EXPERIMENTAL AIR-BORNE INFECTION. Equipment and Methods for the Quantitative Study of Highly Infective Agents; Basic Data on Their Use Obtained with Phenol Red, *Serratia marcescens* and *Bacillus globigii*; and Preliminary Experiments on the Stability and Infectivity for Laboratory Animals of Air-Borne Clouds of *Brucella suis*, *Malleomyces mallei*, *Malleomyces pseudomallei*, *Pasteurella tularensis*, and of Viruses of the Psittacosis Group. Microbiological Monographs, The Society of American Bacteriologists.

By Theodor Rosebury, with the co-authorship and assistance of the staff of the Laboratories of Camp Detrick, Maryland. The Williams & Wilkins Company, Baltimore. \$4.00. xii + 222 pp.; ill. 1947.

This book is the first in a new series of Microbiological Monographs sponsored by the Society of American Bacteriologists. It describes in detail the techniques developed and used in the wartime project on the study of fundamental mechanisms involved in airborne infections. Details of the construction of the buildings and the cloud chamber apparatus are given. The installation was equipped to study highly infective agents under conditions of safety to the operating personnel and others. That these precautions were highly successful is evident from the fact that in six months of operation only one laboratory infection occurred. The infective agents were used in airborne clouds and tested on small laboratory animals in such a manner as to elicit reproducible quantitative data on infection by the inhalation route. The selected bacteria and viruses

were evaluated (1) according to their infectivity for the animals used, and (2) according to their stability after the dispersal by atomization. Finally a combined index of stability and infectivity (or of stability-lethality) was worked out. *P. tularensis* (on mice) and *M. pseudomallei* (on hamsters) proved most infective and lethal, in the order given, but *Br. suis* and psittacosis virus were first and second, respectively, in stability. The combined index puts *Br. suis* and *M. pseudomallei* at the top of the bacterial list.

There is a concise summary at the end of each chapter and a good bibliography and index. Detailed drawings and photographs of the apparatus and its operation add greatly to the text. The wealth of technical detail included will be of interest to anyone studying airborne infections, and the safety measures described ought to be most valuable to any worker handling infective agents under any circumstances. The book is pregnant with possibilities for biological warfare, although that term is scrupulously avoided, even to the extent of avoiding citation of the review of that subject by Rosebury and Kabat.

E. PETRAN



PARASITOLOGY

THE LOUSE: *An Account of the Lice Which Infest Man, Their Medical Importance and Control.*

By Patrick A. Buxton. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$3.25. viii + 164 pp.; text ill. 1946.

This second edition of *The Louse* by P. A. Buxton of the London School of Hygiene and Tropical Medicine is a most useful and informative book about the lice affecting man: the head louse (*Pediculus humanus capitis*), the body louse (*Pediculus humanus corporis*), and the crab louse (*Phthirus pubis*). He has given a thorough and critical review of the world literature through 1944. Much Russian work on louse control during World War II has been included and is not available elsewhere to most American workers. Many comments were based on personal experiences with these insects, which he reared on himself during 1917 and "again (not continuously but most of the time) from 1934 to the present date (1944)."

The first three chapters cover general taxonomy and biology; external and internal anatomy, well illustrated by excellent figures; individual and collective biology, much of it based on Buxton's personal researches with these insects in England, Africa, and India. In regard to the species status of the head and body lice, Buxton follows current usage in recognizing only one taxonomic species (*Pediculus humanus*). He disagrees, however, with contemporary entomologists who maintain that the head louse will assume the characteristics of the body louse (larger size, lighter color, etc.) when confined in boxes applied to the skin of the body, and vice

versa. In one place he has written that "after many generations of being reared under identical conditions the head and body lice remained distinct in general appearance," and "inasmuch as the differences between them seem greater in biology than in anatomy they should be referred to as biological or physiological races. . . they might be called 'species in the making'."

Chapter IV deals with the Medical Importance of *Pediculus humanus*. Human lice are known to transmit typhus fever in Europe, Africa, China, India, and Central and South America. There is a good account of epidemic and endemic typhus and the possibility of one type of typhus gradually becoming the other. American typhus workers designate the causative agent of endemic typhus as *Rickettsia prowazeki* da Rocha Lima (1916), *Rickettsia typhi* Wolbach and Todd (1920), or *R. prowazeki* var. *mooseri* Monteiro (1931). Buxton rather consistently calls this organism *Rickettsia muricola*, a cognomen which dates from 1932. The author emphasizes that the rickettsiae causing typhus fever are transmitted to man through the louse feces, rather than the insect bite, although "it is not possible to state which of these routes, through broken skin, the eye, or the respiratory tract, is the commonest under natural conditions." In discussing relapsing fever, Buxton states that the "spirochaeta is in the body cavity of the louse from which it can only escape if the insect is torn or crushed." During World War I the "cootie," or body louse, was the vector of trench fever, which apparently has disappeared since 1914-1918.

Chapter V, on The Control of Lice, deals thoroughly with the earlier insecticides and mass delousing programs, the lousicides used at the beginning of World War II, such as the thiocyanates, the American A. L. 63 and MYL, and various insecticides used in Russia's war-wrecked cities. The section on DDT is quite adequate, with a good discussion of the powder and its use in mass delousing programs, clothing impregnation, and the use of a DDT hair emulsion for head lice. There is no account, however, of the use of DDT in the Naples typhus epidemic or of its use in preventing wide-spread dissemination of typhus by delousing DP's and other war refugees, since the book was finished in 1945 before this information was generally available.

Vaccine preparation by the laborious Weigl technique, which involves rectal infection of lice with rickettsiae, is mentioned in the final chapter. No mention is made of vaccines prepared from chick embryos, which were used extensively in the Naples typhus epidemic, or of vaccines used in Mexico made from infected mouse or rabbit lung tissue. The bibliography and index appear to be satisfactory and complete.

The Louse is a valuable contribution to medical entomology and a book which every worker in public health would do well to have in his library.

HARRY D. PRATT

HEALTH AND DISEASE

ENTWICKELUNGSGESCHICHTE DES KRANKHEITSBEGRIFFES. *Wiener Beiträge zur Geschichte der Medizin. Band I. Second Edition.*

By Emanuel Berghoff. Wilhelm Mandrich, Wien; Grune & Stratton, New York. \$5.00. viii + 201 pp. 1947.

Before and outside of the Greek tradition, disease was held to be due to supernatural influences. With Hippocrates and Galen, it was derived from a faulty mixture of humors, a hypothesis that survived up to the 19th century. The 17th and 18th centuries provided, in addition, a number of other speculative systems. The 19th century produced the localized, and ultimately cellular, theory of disease, which has been amended by bacteriological, serological, constitutional, and sociological ideas. This whole evolution of the concept of disease is surveyed by the author, a pupil of the great Max Neuburger, competently but without much originality or grace of presentation. In an attempt to embrace too much, only too often too little space is given to a particular development to make the discussion of it very profound or impressive.

ERWIN H. ACKERNECET



PATHOLOGY. *An Introduction to Medicine and Surgery. Second Edition.*

By J. Henry Dible and Thomas B. Davie. Grune and Stratton, New York. \$11.00. x + 946 pp. + 8 plates; text ill. 1947.

This British textbook of pathology, according to the authors' preface, is based upon lectures delivered to medical students in the Universities of Liverpool, Manchester, and Bristol, and in the London School of Medicine for Women. Probably for this reason, the arrangement of the material is rather unusual. Inflammation is the first subject presented; and then follow the general pathological changes associated with vascular disturbances, cellular damage, growth, and immunity. The second portion of the book deals with special bacterial and viral infections. Here the pathogenesis of each infection is stressed, rather than the associated visceral manifestations. In the third portion of the book, regional pathology is covered so as to include the changes due to the specific infections already described, parasitic diseases, and also non-specific endocrine disorders, diseases of the circulatory, respiratory, alimentary, genito-urinary, nervous, and skeletal systems.

The style of presentation is lucid and interesting, and the many illustrations provide an excellent aid to the understanding of the text. It is unfortunate, however, that the authors' opinions of etiology and pathogenesis are so stressed, and that no bibliography

is given to enable the student to read current divergent theories and the historical literature.

ELLA H. OPPENHEIMER



A TEXT-BOOK OF PATHOLOGY. *An Introduction to Medicine. Fifth Edition.*

By William Boyd. Lea and Febiger, Philadelphia.

\$10.00. 1049 pp. + 30 plates; text ill. 1947.

With this edition, Boyd's *Pathology* undoubtedly becomes the most up to date, complete, and readable of the modern textbooks of pathology. Its format is the same as in previous editions, with a division into two parts. The first part includes a survey of general pathology which gives the principles of degenerative changes, metabolic disturbances, inflammation, and repair, as well as the general nature of specific infections, growth, and tumors. The second part is special pathology and includes a complete survey of the pathological changes found in each system. Pathogenesis is stressed, as well as integration of lesions with functional alterations; and the student is well oriented by a review of normal physiology for each system.

The illustrations are numerous and well chosen and an excellent bibliography is appended to each chapter.

ELLA H. OPPENHEIMER



FUNDAMENTALS OF IMMUNOLOGY. *Second Edition.*

By William C. Boyd. Interscience Publishers, New York and London. \$6.00. xviii + 503 pp.; ill. 1947.

In this new edition Boyd's book still retains its place as the outstanding text in immunology, having been brought up to date and revised to keep pace with advances in a rapidly expanding field. The general plan of presenting in one volume both basic and advanced material is retained, so that, as the author notes, the book has value to both students and research workers in the fields of immunology. The last chapter of the text, describing a variety of experimental techniques, should again be pointed out as of particular practical interest; for in it both general immunological and specific clinical methods are presented in sufficient detail to form a basis for such laboratory class work as may be desired.

References to the literature of immunology are extensive and comprehensive, so that the interested reader can readily pursue topics into their more controversial phases if he so desires. At the same time, however, these references are in general treated so as not to overwhelm the beginning student.

A sole suggestion might be offered from the point of view of the general biologist—that a later edition ought to include fuller references to the literature

centering around the influence that immunological concepts are having upon the fields of genetics and embryology, for in this synthesis of ideas those contributed by the immunologist are seen to be playing a role of continually increasing significance.

JOHN E. CUSHING



SYNOPSIS OF ALLERGY. Second Edition.

By Harry L. Alexander. *The C. V. Mosby Company, St. Louis.* \$4.00. 255 pp.; ill. 1947.

In 1941, the author first published his concise and clear *Synopsis of Allergy*, a handbook which has succeeded well in its purpose of providing the student and the physician with a practical conception of the fundamentals of the allergic state and a working knowledge of problems connected with the diagnosis and treatment of its several clinical forms. Another edition of this volume is now needed. The basic information in this field has altered but little in the intervening years, but our conceptions regarding portions of it have gradually shifted. Advances made in the subject are evident from the appearance of some new complexities and many simplifications.

In his position as Clinical Professor of Internal Medicine at the Washington University Medical School, and particularly from his vantage point as editor-in-chief of the *Journal of Allergy*, Alexander has been fully aware of these trends. It must have been a temptation to him, therefore, to increase the scope and possibly the bulk of his second edition, by including in detail many of these ideas and developments. Wisely, it would seem, he has adhered to his original purpose. He has brought his volume up to date but he has retained its brevity and succinctness.

The opening pages deal with the classification of allergic disorders, and their characteristics. The general problems of diagnosis are clearly stated in discussing the technique of collecting clinical data, the value of general laboratory procedures, and the specific test with allergenic extracts by intradermal, ophthalmic, and nasal routes. General measures for avoiding specific offending substances, as well as specific immunization procedures with extracts of the implicated agents, are presented. Tables of dosages of specific extracts, showing schedules of injections, are given with the increases indicated. Such recommended increases are frequently so small as 0.03 cc., even where extracts of such high potency as 10,000 protein N units per cc. are employed. In very sensitive patients, increments of dosage by hundredths rather than tenths of a cc. are prescribed. With such delicate increases in dosage, errors in measurement would seem to be difficult to avoid, even though the clinician provides himself with special syringes. More accurate doses could be attained by employing less potent

extracts with larger increments. Oral immunization measures employed against specific food sensitizations are featured, being given more space, it would seem, than their value deserves.

The chapters upon bronchial asthma and upon hayfever contain comprehensive discussions upon etiology, methods of diagnosis, specific therapy, and various non-specific therapeutic procedures. In the section upon hayfever, consideration of all pollens of purely local importance has wisely been omitted, along with all pollen census figures for the various sections of the United States. Of practical value is the table of ragweed pollen distribution, which is given near the close of the book.

In the chapter upon allergic dermatoses, Alexander has discussed acute and chronic urticaria, allergic purpura, neurodermatitis, and contact and fungus dermatitis. Means of detection and of treatment are given, many prescriptions for local use being included. Adequate discussion is given to the various forms of occupational dermatitis, which have greatly enhanced the importance and the complexity of this form of allergy within recent years. Gastrointestinal, physical, drug and serum allergies are concisely treated. The appendix contains such important and necessary information as methods of preparing diagnostic allergenic extracts for intradermal use. There are lists of the more important of such specific extracts, e.g., of pollens; of the non-seasonal inhalants such as animal danders, vegetable powders, etc.; and of the principal foods which are most regularly employed in skin testing. The potencies proper for testing are designated, and the several methods of determining the specific activity of diagnostic and therapeutic extracts are compared. The patch-testing procedure is described. The author has shown much restraint in preparing this new edition—many theories and speculative ideas could easily have crept in, which would have defeated the purpose of the book. Alexander is to be congratulated upon providing a concise, accurate, and practical compendium upon allergy.

W. C. SPAIN



BUILDING SKIN BEAUTY.

By Mary MacFadyen; illustrations by Frank H. Netter. *Emerson Books, New York.* 25 cents (paper). 32 pp.; ill. 1947.

This, a paper-bound pamphlet for streetcar reading by the maiden or matron, and containing thirty pages, gives good advice on everyday skin care of the face and hands. Unfortunately it does not state which soaps are "strong" and which are "mild," nor does it mention the growing importance of detergents as substitutes for soap. "Cold cream" is not defined, nor is the quackery in the sales-talk jargon boosting many so-called

"creams" pointed out. A short, sound discussion of acne vulgaris is presented, although the role of diet, held to be a cause of this disease, is probably incorrect. The author might well have included a paragraph on ill effects of over-exposure to the sun.

HANFORD H. HOPKINS



ESSAI DE PHYSIOPATHOLOGIE THYRO-HYPOPHYSAIRE.
Etudes cliniques, thérapeutiques et expérimentales.

By Jacques Mahaux, with preface by E. J. Bigwood.
Masson et Cie., Paris; Editions Desoer, Liège. 530
fr. (paper). x + 267 pp. + 1 table; ill. 1947.

According to Mahaux, the thyrotrophic factor of the pituitary has two functions. One is to stimulate the thyroid gland; the other is to combine with the thyroid hormone to form a physiologically active complex. This complex is supposed to have a specific stimulating action on the vegetative centers of the hypothalamus. Mahaux cites a number of facts from the literature and from his clinical and laboratory experience, which have led him to his theory. Certain doubts may be entertained as to the validity of the author's arguments. However, the book is well written and likely to stimulate fresh thinking. A great number of authors, cited in the text of the book, fail to appear in the bibliography. This is indeed to be regretted, for the author seems to have made an extensive study of the pertinent literature in order to prove his point.

WALTER FLEISCHMANN



ENDOGENEOUS ENDOCRINOTHERAPY. *Including the Causal Cure of Cancer Compendium.*

By Jules Samuels. Holdert and Company, Amsterdam. \$10.00. 541 pp. + 38 plates. 1947.

The author's system of medicine is based on three assumptions: first, that many major diseases, such as, for instance, hypertension, chronic arthritis, cirrhosis of the liver, multiple sclerosis, gastric ulcer, and cancer, are due to an unbalance of the production of pituitary hormones; second, that this unbalance of pituitary hormones can be determined by spectroscopic examination of the blood; and third, that these diseases can be cured by irradiating the pituitary gland with short waves. The author is very confident in the value of such therapy. In the chapter on carcinoma of the breast the author writes: "We must therefore endeavor to get the patient for treatment if possible already in the first or second stage. If the woman is informed—by making it widely known—of the good results which are obtained at these stages with a harmless method of treatment, causing her no pain, especially that she will be cured, retaining her breast, then she will not hesitate to apply for treatment already at the first symptoms" (p.

504—italics in original). The few and sketchy case histories and the lack of any statistics make it difficult, if not impossible, to evaluate the author's claims. The reviewer could not be convinced that the book contains anything of value except the bibliography.

WALTER FLEISCHMANN



MÉTHODE GÉNÉTIQUE ET TUBERCULOSE PULMONAIRE.
Travail de la Clinique de la Tuberculose de l'Hôpital Laennec et de l'Institut National d'Hygiène.

By Jean Troisier and J. van der Stegen. Masson et Cie., Paris. 45 fr. (paper). 103 pp.; ill. 1944. The contents of this diminutive monograph, published in France during the war, consist of two heterogeneous sections. In the first part, the authors review earlier studies on genetically determined variations in susceptibility to tuberculosis. From there they proceed to prepare the reader for a more complete appreciation of their own work by explaining some elementary facts of inheritance regarding blood groups, eye color, and the capacity for tasting PTC.

The second part is a poorly tabulated and statistically naive report on the authors' investigation of the offspring of 9 sets of parents, one of whom had clinical tuberculosis. By comparing the eye color, blood group, and cranial indices of 15 tuberculous and 14 non-tuberculous children with those of their parents, they set out to find certain hereditary traits associated with prognosticable susceptibility to tuberculosis. To the surprise of no one familiar with the inadequacy of their procedure, they found them. Without reservation, the book can be recommended for the purpose of demonstrating how studies in human genetics should not be conducted.

FRANZ J. KALLMANN



A GUIDE FOR THE TUBERCULOUS PATIENT.

By G. S. Erwin; American edition revised and edited by Henry C. Sweany. Grune & Stratton, New York. \$1.50. x + 126 pp. 1946.

The clearly stated and fully accomplished purpose of this unpretentious book of popular appeal is the education of the tuberculous patient with respect to the nature, the various methods of treatment, and the public health aspects of his illness. The etiologic, diagnostic, and social problems of the disease are discussed in plain language and with a minimum of technical terms, which are fully explained. All the practical directions given with regard to the emotional, eugenic, and economic aspects of readjustment are sound, well formulated, and free of banal generalizations. In fact, the booklet contains so many essential facts about the clinical and social pathology of tuberculosis, and it presents them in so easily digestible a

form, that it can be fully recommended not only to those suffering from the disease, but also to any other student of this particular subject.

FRANZ J. KALLMANN



HEARING AND DEAFNESS; *A Guide for Laymen.*

Edited by Hallowell Davis. *Murray Hill Books, New York and Toronto.* \$5.00. xvi + 496 pp.; ill. 1947.

Thirteen authors have collaborated with Hallowell Davis in producing this book, which also has a Foreword by Louise Tracy, and an Introduction by C. Stewart Nash. The book is divided into six main sections, with a total of 19 chapters. The first chapter, written by the editor, Hallowell Davis, is also the first section and is really a further introduction to the problems of hearing and deafness as they are covered in this book. The aims and plan of the book are described here. The second section covers general problems of hearing and hearing loss, and includes four chapters. Two chapters, one on the physics and psychology of hearing, the other on its anatomy and physiology, were written by Davis. There is also a chapter on the medical aspects of hearing loss, by E. P. Fowler, and a chapter on the surgical treatment of hearing loss, by T. E. Walsh. The third section has two chapters on tests of hearing and hearing aids, and one chapter on the choice and use of hearing aids, by S. R. Silverman and S. Gordon Taylor.

The fourth section covers problems of rehabilitation, with chapters by M. D. Pauls on speech reading, on auditory training and conservation of speech by R. Carhart, and on military aural rehabilitation by N. Canfield and L. E. Morrisett. The fifth section discusses education and psychology, with three chapters on deaf and hard-of-hearing children by S. R. Silverman, and one chapter on the psychology of the deaf adult by D. A. Ramsdell. The last section is on social and economic problems, with three chapters: B. C. Wright discusses organizations for the deaf; A. M. Hill, employment problems of the deaf; and H. R. Myklebust, vocational guidance. There is in addition an excellent appendix of word lists used in various tests of deafness which should prove useful to audiologists in general.

In a review of a book that is an edited compilation like this one, it is sometimes difficult to discuss certain sections of the book without doing an injustice to other authors. With this book it is not really necessary to discuss individual sections. Every contributor is well qualified to write on his chosen topics, and every one has done a good job. The aim of the book was to provide information about hearing and deafness for the intelligent layman, and for workers in this field as well. It is almost enough to say that this aim has been accomplished as well as it seems possible. The language is non-technical wherever possible, but there is no

sacrifice of scientific truth or facts. The many writers have apparently worked together well, for it is almost impossible to detect any major differences in the style of writing from chapter to chapter. Difficult concepts are discussed with utmost clarity, and the nontechnical language of the book does not at all detract from its value as a source of information.

The reviewer is, in fact, enthusiastic about the book. There have been so many attempts to write good scientific material for public consumption which have failed, either because in popularization truth and facts have been sacrificed, or because the writer has really failed to make his language intelligible to the layman. Neither of these difficulties can be found here. The writers set out to accomplish a worthwhile aim, and they have certainly achieved it.

W. R. GARNER



AMERICAN MEDICAL RESEARCH, *Past and Present. A Monograph Study of the New York Academy of Medicine Committee on Medicine and the Changing Order.*

By Richard H. Shryock. *The Commonwealth Fund, New York.* \$2.50. xviii + 350 pp. 1947.

Medical research, and research in general, enjoy by now in this country almost the prestige they deserve. This is a relatively recent development. In a chapter on formative influences the author shows for what economic and moral reasons medical research did not develop on a large scale in this country during the greater part of the 19th century. Some of these trends still subsist, as evidenced by the amount of time and energy wasted by the medical profession almost every year in almost every state in order to maintain the right of animal experimentation.

Early support for medical research was obtained in the period 1860-95 primarily in the field of veterinary medicine, under the influence of the practical success of the new bacteriology, and under the impress of German systems of research organization. Still, in its first period of great achievement American research was, more than research in any other country, dependent upon private support. The author has analysed the different forms of private support under the several headings of the foundations, professional institutions, universities, and corporations.

Every war since 1860 has brought increasing governmental support to medical research, a trend culminating in the giant enterprises of the Committee on Medical Research during World War II and the plans expressed in the Kilgore, Magnusson, and other bills.

Besides an accurate description of the organizational forms of research, Shryock has also supplied a competent survey of the contents of 20th century research, its trends, fields, and the reciprocal influences of research and practice. A special chapter is devoted to the

"public relations" of medical research, and in a thoughtful finale an attitude of "qualified optimism" is adopted.

One of the outstanding virtues of this book is that technical details are organically connected with social background and general trends. It is a most artful blending of historical analysis and recent survey, or, to say it in medical terms, of anamnesis, physical examination, and prognosis. It does not remain on the descriptive level; its courageous criticism leads up to well-balanced judgments. It confirms the author's position as one of the leading medical historians in this country. It should be read by everybody interested in either science or history.

ERWIN H. ACKERKNECHT



STANDARD METHODS OF THE DIVISION OF LABORATORIES AND RESEARCH OF THE NEW YORK STATE DEPARTMENT OF HEALTH. *Third Edition.*

By Augustus B. Wadsworth, with a foreword by Gilbert Duldorf. The Williams & Wilkins Company, Baltimore. \$10.00. xxxvi + 990 pp.; ill. 1947.

This valuable book of laboratory procedures has been revised and on the whole brought very well up to date. There are new chapters on the Spectroscopic Laboratories, on Gasometric Analysis, and on Biologic Assay. A complete revision has been made in the routine methods for the serological diagnosis of syphilis. The new antigen composed of cardiolipin, lecithin, and cholesterol has been substituted for the cholesterolized alcoholic extract of beef heart. The chapters on Actinomycosis and Mycotic Diseases, Protozoa, and Parasitic Worms have been greatly enlarged.

Many of the culture media recommended are still those of the 1939 edition. The newer peptones that are now being used in place of infusion bases have not been included. A direct plating medium for the detection of *C. diphtheriae* is not advocated. Laboratory diagnosis of diphtheria is still based on the microscopic examination of cultures on coagulated-serum medium. Endo and eosin methylene blue plates are still recommended for use, along with bismuth sulfite and citrate agars, for the enteric group. No mention is made of DCLS or SS. These examples illustrate some of the more glaring omissions.

New sections have been included on the preparation of fluid tetanus toxoid, on precipitated diphtheria-tetanus toxoid, on enzyme concentration of antitoxic sera, and on the preparation and standardization of phase I pertussis vaccine.

The appendix contains the provisions of the New York State laws and Sanitary Code relating to Approved Laboratories, postal laws and regulations regarding the mailing of specimens and cultures of pathogenic micro-organisms, and a description of outfits used for the submission of specimens.

This volume definitely belongs in the libraries of all medical and public health laboratories for its wealth of readily available information.

E. PETRAN



PSYCHOLOGY AND ANIMAL BEHAVIOR

CURRENT TRENDS IN PSYCHOLOGY.

By Wayne Dennis, B. F. Skinner, Robert R. Sears, E. Lowell Kelly, Carl Rogers, John C. Flanagan, Clifford T. Morgan, and Rensis Likert. University of Pittsburgh Press, Pittsburgh. \$3.50. x + 225 pp. 1947.

On March 5 and 6, 1947, a conference on current trends in psychology was held at the University of Pittsburgh. Specialists in various fields of psychology were asked to speak on trends in their fields, and this book contains these various discussions on the status of the different fields as seen by the speakers. One chapter in the book is given over to each of the talks.

In the first chapter, Wayne Dennis discusses Psychology as a Profession. Psychology has grown tremendously in the past few years, and this growth has led to many new problems. The public has, during this period of growth, come to accept psychology more and more. This growth and acceptance lead to many problems with which psychologists have not had to contend before, namely, problems such as the certification of psychologists and restrictions on the use of the term. Dennis feels that psychologists should spend a little more time applying certain psychological principles to their own problems of selecting and training personnel.

B. F. Skinner writes on Experimental Psychology. To Skinner, experimental psychology can no longer be defined in terms of a restricted subject matter. Most fields of psychology are now experimental. The thing which distinguishes the experimental psychologist is his interest in understanding behavior and in formulating theories to account for behavior. At least that is what the experimental psychologist should be doing. Skinner is concerned primarily with the academic experimental psychologist, and his remarks do not seem so much to indicate a trend as to indicate what he thinks they ought to be doing, and perhaps what the academic psychologist will be forced to do. It seems to the reviewer that the main trend in experimental psychology is that it is moving out of the academic atmosphere in many places. The subject matter of experimental psychology has become complicated, and better experimental facilities are required. The academic psychologist may be the only one left to take care of theory, and in turn theory may be all that is left for the academic psychologist.

Robert R. Sears, in his chapter on Child Psychology, tells us that the subject matter of this field is changing. Now there is more emphasis on the molar, rather than

segmental, behavior of children; more emphasis on the learning process; and more emphasis on the social setting. Child psychology shows a trend toward a systematic molar theory of development. In this trend, some of the older techniques of tests and instrumental recording are dropping out, and newer techniques of observational sampling and projective tests are being used. These do seem to constitute a trend in child psychology.

E. Lowell Kelly discusses Clinical Psychology. The major trend here is that there are getting to be so many clinical psychologists. Clinical psychology was long scorned and shunned by the very departments which are now turning out hundreds of clinical PhD's. These many new psychologists, now practising, bring about many of the certification and training problems mentioned earlier by Dennis. Another trend in clinical psychology is toward development of the psychiatric team, made up of a psychologist, a psychiatrist, and a social worker who diagnose and treat as a team. Kelly is very much in favor of this type of teamwork.

Carl R. Rogers, writing on Psychotherapy, feels that the main trends in this field are toward objectivity in therapy, and toward client-centered therapy. He is probably right, if published literature is a good indication. Rogers disagrees with Kelly, however, in his feeling that team therapy is dropping out and that individual therapy is becoming more important.

John C. Flanagan, in Personnel Psychology, discusses the history of individual differences. He finds no good information derivable from an analysis of publications, but his analysis is in terms of percentages, not number of publications. The major trend for the future seems to be that there will be much more personnel selection.

Clifford T. Morgan writes about Human Engineering, and briefly discusses its history, which was primarily during the years of the recent war. Human engineering is concerned mainly with the working environment, work and the workplace, and the design of instruments. During the war, much of the research on these problems was applied, useful in a limited area of application. More and more emphasis is being placed on fundamental research in this area, and we already see evidence of the great amount of work which can and needs to be done. In a way, human engineering is the one really new development in psychology, having had its greatest growth in the last ten years.

Rensis Likert, in the last chapter, discusses the Sample Interview Survey. He illustrates the information which can be obtained from the sample interview with a national survey by the Department of Agriculture for the Board of Governors of the Federal Reserve System. This illustration also shows very carefully the requisite steps in undertaking a large scale interview. Likert's main prediction of trends arises from his own enthusiasm for the method and his confidence that surveys will be an important research tool in the future.

In summary, this book has some useful information. Probably all writers are overly enthusiastic about their own fields, and each feels that his own area of interest is becoming more important relative to the others. The truth is probably that all fields of psychology have grown greatly in the past few years, and will continue to grow in the future. There is much less *shift* of emphasis than simply an *increased* emphasis on all fields. It is unfortunate that Physiological Psychology was omitted, since it too seems to have its trends; but there were apparently practical considerations which made it impossible to include this field.

W. R. GARNER



THE PSYCHOLOGY OF NORMAN PEOPLE. *Revised Edition.*

By Joseph Tiffin, Frederic B. Knight, and Estion Jackson Asher. D. C. Heath and Company, Boston. \$3.50. xvi + 581 pp.; ill. 1946.

This book is the second edition of a textbook for courses in Introductory Psychology. In most respects the book is not different from the first edition, with the exception of some minor rearrangement of chapters, and the addition of some new material in a few of the chapters. The text was written primarily for students not expecting to specialize in psychology, but expecting to go into fields of business, engineering, etc. The emphases, in accord with the expected use of the text, are on individual differences, personality, and similar topics. The writing is readable, and illustrations are ample, features which make this text reasonably satisfactory for many courses.

W. R. GARNER



THE PSYCHOLOGY OF EGO-INVOLVEMENTS: *Social Attitudes and Identifications.* Wiley Publications in Psychology.

By Muzafer Sherif and Hadley Cantril. John Wiley & Sons, New York; Chapman & Hall, London. \$6.00. viii + 525 pp. 1947.

The authors of this book use the word *ego* reluctantly, because the word has been used in so many ways that they are afraid that their own meaning will be misinterpreted. Thus they are careful to state explicitly what they mean when they use the word *ego*. To them, "the ego consists of many attitudes which from infancy on are related to the delimited, differentiated and accumulating 'I,' 'me,' 'mine' experiences. These attitudes, which may be designated as ego-attitudes, are constituent components of the ego. Apart from the constellation of these ego-attitudes, there is no such entity as the ego." With this definition of the ego, their study becomes primarily a study of attitudes,

particularly those attitudes which are self-oriented or directed.

The first few chapters are concerned primarily with an experimental study and definition of the ego. Can it be demonstrated in the laboratory? Under what conditions is the ego an effective concept in describing the nature of perception? The authors find certain relations to hold. Ego-attitudes determine the nature of a perception when the perception is otherwise loosely organized. And instructions have the greatest effect when they are in accord with the subject's own attitudes. Relations such as these are found in experimental literature, and certainly add weight to these authors' concept of the ego as an objectively identifiable part of an individual.

The authors insist that the only ego they are interested in is one which can be objectively demonstrated, one which is not mysteriously innate, one which is dependent on environmental training and momentary environmental stresses. Particularly in the first half of the book they make out a good case for such an ego. Their ego seems to be one which can be experimented on in the laboratory. But inasmuch as their definition of the ego is in terms of attitudes, the last half of the book deals primarily with many illustrations of the ways in which attitudes are formed and changed, the development of attitudes, and the importance of attitudes. In these illustrations, the authors seem to keep clearly in mind that they are dealing only with self-oriented attitudes, and many of their points seem well made. At times one is reminded a little too much of the case-history variety of books on sociology, and the book becomes progressively weaker toward the end—weaker in terms of holding to an objective ego.

The authors have provided us with a book which is interesting to read, although the language is rather involved at times. They have made a case for an objective ego, and thus have made a significant contribution, since it seems to the reviewer that any successful attempt to objectify even some of the concepts of personality and social psychology must be a significant contribution.

W. R. GARNER

PSYCHOLOGY FOR NURSES.

By Mandel Sherman. Longmans, Green and Company, New York, London, and Toronto. \$2.75. xvi + 237 pp. + 2 plates; ill. 1947.

This is an "easy" textbook of general psychology with content especially chosen for interest to nurses in training. The topics of sensation and perception are sacrificed for an expanded treatment of intelligence, mental tests, and emotions. The text is written in a pleasant, readable style, and to each chapter there is appended a list of questions for discussion. The book appears to be

admirably suited for its purpose and might well be adapted to other terminal short courses, because it is both "popular" and sound.

STANLEY B. WILLIAMS



HOW OUR MINDS WORK.

By C. E. M. Joad. Philosophical Library, New York. \$2.75. viii + 116 pp. [No date.]

Joad is a philosopher and he has presented us with a quaint and well-mannered essay on the ancient and familiar mind-body problem. This is an issue which vexed psychology more a generation ago than it does today, and unfortunately Joad's treatment of it is of about that vintage. Though in part the issue may prove to be a timeless one, the essay might have benefited from more consultation of recent psychological thought. Joad writes persuasively and concisely and has, in surprisingly few words, stated the case for a modified idealism, a view which makes a place for a separate entity or force called "mind."

STANLEY B. WILLIAMS



THE THINKING MACHINE.

By Edward Podolsky. The Beechhurst Press, New York. \$3.50. 232 pp. + 8 plates; ill. 1947.

This book contains a close-up photograph of the brain of the Nazi, Robert Ley. Otherwise there is nothing in it to interest the scholar, and much to make him cringe. The reputable scientists who find their experiments summarized here may well wonder whether it is worth being popularized if it has to be done in a context of ignorance.

STANLEY B. WILLIAMS



DEVELOPMENTAL DIAGNOSIS: Normal and Abnormal Child Development. Clinical Methods and Pediatric Applications. Second Edition.

By Arnold Gesell and Catherine S. Amatruda. Paul B. Hoeber, New York and London. \$7.50. xvi + 496 pp.; text ill. 1947.

Again Arnold Gesell, with his associate Catherine Amatruda, presents a well-written, thoroughly scientific, practical, and comprehensive volume on child development. The thesis of this book is that by a careful examination of an individual child, with reference to behavior norms for specific ages, a physician may identify behavior abnormalities in patients as early as the age of 8 weeks. Early diagnosis of amentia in any degree, of diffuse or specific brain lesions, of precocity, of blindness, or of deafness is a great advantage in hand-

ling a child and directing his subsequent development intelligently.

Developmental Diagnosis is a handbook, really, for every physician who sees children. Part I informs the clinician how to examine a child's behavior responses accurately. Norms for infants from 4 weeks to 36 months are given, and the procedure for equating a child's "developmental quotient" is carefully described. Part II is devoted to detailed but never labored discussions of twelve types of abnormalities which affect the total development of children. In this section a number of succinct developmental histories amply illustrate the effectiveness of the authors' methods. Throughout the book emphasis is consistently placed on the doctor's responsibility to recognize and help patient and family deal with actual developmental capacities realistically. In Part III this point of view is further amplified by a chapter on Diagnosis and Guidance and a second on Developmental Pediatrics.

It is a great satisfaction to know that this book has now appeared in a second and expanded edition. This is indicative of a demand in pediatric medicine for better understanding of individual children, their individual growth potentialities, and their individual needs.

HELEN HEWITT ARTHUR



THE PERSONALITY OF THE PRESCHOOL CHILD. *The Child's Search for His Self.*

By Werner Wolff. Grune & Stratton, New York. \$5.00. xvi + 341 pp.; ill. 1946.

Personality dynamics, as expressed in the child's search for himself, is the contribution of this extensive volume. Overt child behavior has been fully investigated by Gesell and others, but the underlying forces that motivate this behavior have not been understood. An essential feature of Wolff's approach is revealed in his opposition to Piaget, as expressed (pp. 17-18) in the belief that a child is more concerned with thoughts than with objects, is more original than imitative, and has thoughts unrealistic rather than exclusively realistic. To support these theses and many others, a tremendous amount of recorded material is advanced. These illustrative excerpts do much to confirm the reader in the belief that "from the viewpoint of adult behavior, the child's attitudes have the characteristics of pathological or even schizophrenic reactions" (p. 31). They may also be said to be the only sections of the book that are easy to read. The author's style is a difficult one. Many of the sentences are very Germanic in structure and length. Beyond this, there are instances of incoherence, reminiscent of the very thinking of preschool children! An example reads: "The formation of an ideal is based upon the child's tendency to imitation, whereby the child tries to adjust himself to his

environment. Experiencing that he is not able to have the same power and success as those people whom the child wishes to imitate, these persons become ideals" (p. 55). To be perfectly fair it must be said, too, that there are passages of great clarity; and by evading the sections containing spiritualistic and mystical overtones, some examples of fine prose may be found.

The first section, entitled Observation, is the part of the book perhaps least open to criticism. One can quarrel very little with the recorded data here, although the interpretations are certainly highly subjective in many instances. An illustration of the growth of "genuine social relationships and mutual understanding" shows at least some aggressive tension if the whole dialogue is examined:

Philip: "Oh, I dropped my stick."

Henry (retrieving it clumsily): "I picked up your stick for you. Wasn't that nice of me, Philip? Wasn't that nice? [Pause—working at clay.] We won't stop this all day—we'll just stay here. We'll be here all the time—all alone. The grownups will be dead. We'll hurt them dead and they won't be here. We'll be playing with the dumb-waiter all the time. I pull it up and you pull it down." (p. 63.)

This is interpreted as the effect of resentment against adults assisting in the development of social relationships. Obviously other interpretations may be made.

The second section, Experimentation, is even more open to question in regard to some of the reported findings. Here dreams, drawings, stories, and behavior of children are interpreted by "expressive analysis." The individual associations of the children are the bases of the interpretations. Explanation of the title of this section is hard to find.

The discussion of the Binet intelligence test measuring emotion is interesting but unconvincing. The thesis seems to be that in responding to a question designed to measure intelligence, e.g., "What's the thing for you to do when you are on your way to school and see that you are in danger of being late," a child expresses an emotion, "I would go home." This tells about the child's psychic tensions, negative environment, etc., says Wolff, "but nothing about intelligence." This certainly seems to require proof!

The third section, entitled Theory, is indeed a highly theoretical treatise. Many interesting and challenging possibilities for further research are presented. Wolff's comparison of his own approach, "experimental depth psychology," with those of Claparède, Stern, and Gesell is worth reading, as is his description of the steps and techniques of what he calls "experimentation."

A word of appreciation should be given to the children's drawings, which are most delightful and do much to brighten the text. The typeface is well chosen. There is an author index, a subject index, and a bibliography of 628 titles.

ARTHUR LICHTENSTEIN

THE PSYCHOLOGY OF ADOLESCENCE. *Third Edition. Prentice-Hall Psychology Series.*

By Karl C. Garrison. Prentice-Hall, New York. \$4.65 (trade edition); \$3.50 (text edition). xx + 355 pp.; ill. 1946.

This third edition of Garrison's textbook is similar to the previous ones. It is divided into four sections, an introduction, a section on the facts of development during adolescence, a section on the personality of the adolescent, and a final section on guidance.

It is a self-contained elementary textbook. It introduces the various topics with sufficient background to make them intelligible without much prerequisite knowledge. It is thoroughly documented from empirical investigations of adolescence, and it presents both sides of many controversial issues—in other words it is a scholarly presentation. It is a factual book with a minimum of theoretical interpretation. As such it certainly serves a function. It is probably useful reading for either an adolescent or his parent. The central weakness of the book is its failure to picture the adolescent as a live, understandable person. After reading the book, an adolescent may know that other people are having the same troubles as his, but he is not likely to understand the reasons for his feelings. The parent is not helped to see the world through the eyes of an adolescent. The notable absence of reference to psychoanalytic ideas about adolescents indicates a lack of emphasis upon the internal dynamics. In other words, the book is accurate and academically scientific, but it lacks warmth of understanding of personality. Rather surprisingly, the bibliography includes a selection of fictional treatments of adolescence.

ALFRED L. BALDWIN



IMPROVABILITY OF PITCH DISCRIMINATION. *Psychological Monographs, Volume 58, Number 2, Whole Number 267.*

By Ruth F. Wyatt. The American Psychological Association, Northwestern University, Evanston, Illinois. \$1.25 (paper). vi + 58 pp. 1945.

In this significant study it is shown that both musically trained and untrained subjects can improve their pitch discrimination by special training, to a point where the musically untrained subjects are better at the end of training than the musical subjects were to start with, although of course the latter have continued to keep ahead. Training at one frequency is transferrable to a significant degree to octave frequencies on either side of the training frequency, but improvement is not so great as at the training frequency.



PSYCHOLOGICAL TESTING.

By James L. Mursell. Longmans, Green and Com-

pany, New York, London and Toronto. \$4.00. xiv + 449 pp. 1947.

The mental testing movement is nearly a half century old, yet it still is almost impossible to find a good up-to-date handbook for use in advanced college courses. Handbooks, special-topic books, yearbooks, critiques, and journal articles are abundant but generally lack one feature or another required of a genuine introduction to the field. Mursell has by no means supplied the perfect text, but he has done a creditable job of trying to. His book leaves the impression of having been written by a teacher rather than by a researcher. Quite a lot of it is assembled rather obviously from secondary sources, some of it uncritically. The teacher's emphasis, too, is apparent in the selection of topics. Mursell evidently wants the student to understand the general logic of test construction and interpretation, in clear English words and sentences, and to steer clear of many controversial issues. As a teacher, I should say he succeeds quite admirably in this, as well as in giving a fair portrayal of the status of psychological tests today. His keynotes are caution in interpretation and fairness to all views, marks of eclectic scholarship. No one could write such a text and not be superficial at times, or fail to omit what others regard as significant, or occasionally conclude just the opposite of what some specialists have established. Mursell is no exception. But the paucity of good textbooks in this field may just possibly reflect a basic difficulty of subject matter rather than the inabilities of authors. A well-informed teacher could use this textbook to good advantage, for basically it is sound and scholarly. It can be read with profit even by one who doesn't yet know what this "IQ and mental test stuff" is all about.

As to topics, Mursell devotes far and away the greatest share of space to the main stream of intelligence testing. The treatment of personality and motor-functions is cursory, as is the treatment of special analytic procedures such as factor analysis. Nor are the test developments of the recent war adequately covered. Nevertheless, it must be admitted that adequate coverage of all topics would require a much larger book than would be practicable. Until the definitive treatment appears, this book will serve as a useful substitute.

STANLEY B. WILLIAMS



THE RELATIONSHIP BETWEEN CONTENT OF AN ADULT INTELLIGENCE TEST AND INTELLIGENCE TEST SCORE AS A FUNCTION OF AGE. *Teachers College, Columbia University Contributions to Education, Number 933.*

By Rose Estrin Kushner. Bureau of Publications, Teachers College, Columbia University, New York. viii + 59 pp. 1947.

This is a technical monograph of little or no interest to the general or scientific public. It deals with a specific

problem of interest only to mental test constructors. Certain subtests in adult intelligence tests are shown not to influence the total score differentially with age, as had been supposed by other investigators.

STANLEY B. WILLIAMS



THE THEMATIC APPERCEPTION TEST. *The Theory and Technique of Interpretation.*

By Silvan S. Tomkins with the collaboration of Elizabeth J. Tomkins. Grune and Stratton, New York.

\$5.00. xii + 297 pp. 1947.

Recent years have seen the rise of the so-called "projective" tests of personality, which rely not on direct questioning but on indirection. A person is asked to supply the meaning to an essentially ambiguous situation—ink-blot, unfinished sentences, mutilated speech, or the like—and in so doing is likely to reveal quite unintentionally a great deal about his innermost wishes, fears, and habits of thought. The tests are claimed by admirers to be analytic of basic personality structure but by others are regarded merely as convenient ways of getting people to speak frankly of personal matters. The best known and most studied are the Rorschach ink-blot. The Thematic Apperception Test (TAT), developed by Murray and his associates at the Harvard Psychological Clinic in the 1930's is becoming nearly as popular as the ink-blot. Its unique character is the use of pictures of people in social situations, such as might appear as illustrations for a magazine story. The required test behavior is the elaboration of a story to fit each of 20 standard pictures. In telling the stories the testee draws on his imaginative resources without restraint and often can keep a hidden stenographer very busy with verbatim recording. Records are even more laborious to analyse and interpret than to transcribe. There are, as yet, few standard rules that are generally accepted among the "trade," although most investigators hope that such rules will be worked out eventually. Until they are, the stories will continue to be evaluated—just as are people—according to one's own brand of personality theory. The degree of subjectivism introduced thereby is the degree to which the projective test is not a true measuring instrument of scientific value. Admittedly, it takes years of patient research to achieve genuine standardization. Tomkins outlines in his book a tentative method for interpreting the stories, which, it is hoped, will further the progress of standardizing. The method is his own and is slightly different from the original method of Murray.

Most of the pages of this book are taken up with illustrative case material, which is more voluminous, perhaps, than is necessary. The historical introduction is too brief to be satisfactory. Of chief interest are two sections: the first, an application of Mill's principles of logical analysis (methods of agreement,

concomitant variation, etc.) to the story material; the second, a novel statement of the theory of repression, cast in quantitative terminology. Neither contribution is sufficiently integrated with the TAT material. However, despite these shortcomings, the book is the best over-all treatment of the TAT and will for that reason alone find a place in the library of the clinician as a useful reference.

STANLEY B. WILLIAMS



MENTAL MISCHIEF AND EMOTIONAL CONFLICTS. *Psychiatry and Psychology in Plain English.*

By William S. Sadler. The C. V. Mosby Company, St. Louis. \$6.00. 396 pp. 1947.

This is an addition to the rapidly growing bibliotheca of popularized psychiatric-psychological literature, but it is superior to much of this material in a number of respects. The author's competence is beyond question. His style is lucid, and his explanatory passages really explain. The illustrative cases are wisely selected, not for sensationalism or melodrama, but for clarification of the exposition.

While tracing the sources of symptomatized phenomena of mental illness and related areas well below the surface, the author handles theories and concepts, the adequacy of which is yet to be fully demonstrated, with admirable reserve. Two illustrations may suffice: (1) the discussion of telepathy (Chapter 26); and (2) the references to psychoanalysis (several places, particularly Chapter 20). The latter Chapter, on Sexual Problems, is incidentally very well-handled throughout.

One feature of the book that proved most annoying was the frequent indulgence in upper case and italic type, particularly the latter. This gives the page a most *sensational* appearance, fortunately quite misleading. In many instances it is impossible to find any logical basis for this procedure, unless it be variety in visual stimulation.

In sum, in view of its sound, comprehensive approach and wealth of useful case material, this is a justifiable addition to the library of the physician, psychiatrist, or psychologist, and for the layman a book several strata above the general run of the popular psychological mill.

ARTHUR LICHTENSTEIN



PSYCHIATRIC RESEARCH. *Papers read at the dedication of the Laboratory for Biochemical Research, McLean Hospital, Waverley, Massachusetts, May 17, 1946. Harvard University Monographs in Medicine and Public Health, Number 9.*

By Cecil K. Drinker, Jordi Folch, Stanley Cobb, Herbert S. Gasser, Wilder Penfield and Edward A. Strecker. Harvard University Press, Cambridge. \$2.00. xii + 115 pp. + 5 plates; ill. 1947.

In this little volume of dedication papers, Cecil K. Drinker begins with a historical account of research at the McLean Hospital. Jordi Folch follows with a discussion of Biochemical Problems Related To Psychiatry; Stanley Cobb discusses the Integration of Medical and Psychiatric Problems: A Report of Progress; Herbert S. Gasser offers a Protocol For A Review Of Psychiatry; Wilder Penfield contributes a paper on Psychical Seizures; and Edward A. Strecker concludes with a discussion of The Psychobiology Of Psychiatric Research. These papers set a rather high standard, and several of them bring together into convenient form considerable new material for which the reader would otherwise have to comb the literature.

WENDELL MUNCIE



PRACTICAL PSYCHIATRY AND MENTAL HYGIENE.
McGraw-Hill Series in Nursing.

By Samuel W. Hartwell. McGraw-Hill Book Company, New York and London. \$3.75. xvi + 439 pp. 1947.

This is a textbook in psychiatry and mental hygiene, particularly for the use of nurses. As such it is very readable, contains no gross errors, presents an eclectic view on problems in mental hygiene, and offers an extensive bibliography, glossary, and outline for history-taking. It is amply illustrated with psychiatric cases and emphasizes the mental hygiene of childhood and adult life.

WENDELL MUNCIE



TEACHING PSYCHOTHERAPEUTIC MEDICINE. *An Experimental Course for General Physicians.*

By Walter Bauer, Douglas D. Bond, Henry W. Brosin, Donald W. Hastings, M. Ralph Kaufman, John M. Murray, Thomas A. C. Rennie, John Romano, and Harold G. Wolff. Edited by Helen Leland Witmer; introductory chapter by Geddes Smith. The Commonwealth Fund, New York. \$3.75. x + 464 pp. 1947.

This book is the account of an experimental course in teaching psychotherapeutic medicine, given general practitioners as a pilot course under the aegis of the Commonwealth Fund. The course was given at the University of Minnesota in April 1946, by the several authors listed. Included are lectures and discussions regarding general orientation, clinical problems, history-taking, the patient-physician relationship, normal personality development, psychotherapy, psychoneuroses, anxiety states, various psychosomatic aspects, special therapies, common psychopathology, care of veterans, etc.

It is a very readable account of what must have been

a most interesting experience for everyone concerned, and I have no doubt that the interested general practitioners learned a great deal from such presentations. The book should serve as a guide in the establishment of other similar projects the country over. Special projects could easily be handled in most of the large centers and would not have to be subsidized by any fund. More projects of this sort would certainly be useful both to the general practitioner and to the psychiatrist in establishing better relationships with other medical specialists, and by easing part of the psychiatric load onto the shoulders of other physicians.

WENDELL MUNCIE



THE PRACTICE OF GROUP THERAPY.

Edited by S. R. Slanson, with a foreword by Nolan D. C. Lewis. International Universities Press, New York. \$5.00. 271 pp. 1947.

This is an authoritative accounting of efforts in group therapy, its general principles and dynamics, and its actual practice in various conditions, e.g., children's behavior disorders, psychopathic personalities, psychoneurotic adults, allergy patients, patients with speech disorders, psychotic patients, etc. Child therapy is considered as an activity group therapy; adult therapy, as interview group therapy. There are seventeen different authors, all able to give a good account of various topics.

WENDELL MUNCIE



PSYCHOPATHIC STATES. *Second Edition.*

By D. K. Henderson. W. W. Norton and Company, New York. \$2.50. 158 pp. 1947.

This little book is a reprint of the author's Salmon Memorial Lectures, first published in 1939, and tells about all that is known concerning so-called psychopathic states or constitutional psychopathy. Henderson concludes that social rehabilitation is the method of choice, and he sees little hope from psychoanalytic or other so-called deep therapy in the treatment of such conditions.

WENDELL MUNCIE



HUMAN BIOLOGY

CONFIGURATIONS OF CULTURE GROWTH.

By A. L. Kroeber. University of California Press, Berkeley and Los Angeles. \$7.50. x + 822 pp. 1944.

The reasons for undertaking this work and the aims of

the author are so succinctly stated in the preface that it seems best to repeat them here:

"One of the recognized characteristics of human culture is the tendency of its successes or highest values to occur close together in relatively brief periods within nations or limited areas. While reasons have been adduced for the phenomenon, no systemic examination of the facts seems ever to have been made. I present here the more readily datable facts—for time lapse seems an essential factor of the phenomenon—in an orderly arrangement, as basis for an inductive comparison. The purpose is not so much to offer a final explanation as to make the most pertinent data readily available for those who wish to search farther for a causality. I am convinced that, the phenomenon being cultural, the explanation must first of all be made in cultural terms, even if it be essentially only a descriptive interpretation. The underlying psychology may ultimately be discoverable; but that will necessarily be later. I have offered an adumbration of an explanation in terms of cultural patterns. This will perhaps be considered insufficient. It does not wholly satisfy me. While we know a good deal in detail about some specific culture patterns, we are only in the beginning of understanding of the nature of such patterns; even their theoretical recognition is recent. How some sharply marked patterns in civilization have actually behaved, historically, seems worth knowing as a first empirical step toward understanding; and my main endeavor has been to present organized materials on this behavior."

This work is not light reading. The opening chapter, Problem and Procedure, is perhaps from the general viewpoint the best of all. Here Kroeber states clearly and explicitly what he is undertaking to do, what the limitations are, and reveals his own belief in the dominance of cultural patterns in shaping the achievement of man.

The following chapters, wherein he traces the growth of knowledge and the peaks of achievement and the occurrence of genius, are so crammed with factual data that they may aptly be described as shoals of fact. If these do not deter the casual reader he will find more readable discussions at the end of each of these chapters.

The subjects selected for study are each assigned a chapter. These are Philosophy, Science, Philology, Sculpture, Painting, Drama, Literature, and Music. There is a chapter on the Growth of Nations which serves to organize these data by national units in order to gain a view as to the amount of concurrence of peaks of achievement in the separate fields. Finally, there is a chapter, Review and Conclusions.

This is a tremendous work by one of the most broadly learned scholars of our day. It is comparable in many ways to Toynbee's work. Both men are seeking patterns in history. Their methods of work are different and their view points are separate because of their differing backgrounds. The two works thus supplement each other. Kroeber's achievement lies in his demonstration of the importance of culture in determining the time of occurrence of genius and the flowering of culture.

GEORGE F. CARTER

CULTURAL AND NATURAL AREAS OF NATIVE NORTH AMERICA.

By A. L. Kroeber. *University of California Press, Berkeley and Los Angeles.* \$5.00. xii + 242 pp. + 10 maps + 1 table; text ill. [1939]; 1947.

This reprinting of one of the great works of American anthropology (reviewed Q. R. B. 15: 476. 1940) needs no commendation, but instead a word of welcome at its reappearance.



THE INDIANS OF THE AMERICAS.

By John Collier. *W. W. Norton and Company, New York.* \$3.75. 326 pp. + 8 plates. 1947.

John Collier became commissioner of Indian Affairs when Franklin D. Roosevelt was elected, and he held that post for the following twelve years. Prior to that time he had for some time been active on behalf of the Indians, defending them both against private greed and the actions of the government. This book is an explanation of what he tried to do as Commissioner of Indian Affairs, why he tried to do it, and his personal evaluation of Indian society.

There are two themes that run throughout the book. One is the strength and value of society, and particularly of Indian society. Collier maintains that the Indian had created something unique in his society, and that we have failed completely to recognize it, except in the negative way of trying to destroy it when we found it to be a source of strength to the Indians. All discussion of the Indian peoples of America is from this basic view. The discussion is often poetic, religious, even at times mystic. I do not doubt the value of societies, but many readers would more readily grasp what John Collier is trying to tell them, if he had been more concrete and less poetic. The author's second theme deals with the history of the Indian's European contacts and the aims and processes applied to the breakdown or modification of Indian culture. There is a lengthy treatment of the Spanish record in Latin America, and an equally full treatment of the North American record. Both make sickening reading. Because we are Americans and the subject comes closer home and the oppression and mistreatment reach right into the present, the second section leaves a deeper mark.

Collier is vicious in his attack on the treatment of the Indians by the United States. Most would expect this. Most will be surprised, however, to read Collier's attack on the pre-1929 Indian Service. The very organization that was theoretically to protect and aid the Indian is shown to have been its principal foe and despoiler. It is worth repeating that its destructive attitude and actions continued right up to 1929. In the earlier part of the book Collier has laid the background for understanding what he as Indian Commissioner tried to do. Indian society, including Indian

religion, was no longer to be attacked and, if possible, destroyed. Instead, these were to be encouraged. No longer was the Indian to be converted forcibly into a white man, but rather he was to be encouraged to be as Indian as he liked. He was urged to work out his own solutions to problems in his own way. Collier admits that the program was not completely successful, but he feels that the Indian was given his first "break" since the coming of the white man to North America, that the Indians have in part experienced a spiritual rebirth as a consequence, and that a new era for these good peoples has been opened.

GEORGE F. CARTER



ETHNOGRAPHY AND ACCULTURATION OF THE FORT NELSON SLAVE. *Yale University Publications in Anthropology, Number Thirty-three.*

By John J. Honigsmann.

NOTES ON THE INDIANS OF THE GREAT SLAVE LAKE AREA. *Yale University Publications in Anthropology, Number Thirty-four.*

By J. Alden Mason. *Yale University Press, New Haven; Humphrey Milford, Oxford University Press, London.* \$2.50 (paper). (33) 170 pp.; text ill. (34) 46 pp. + 4 plates; text ill. 1946.

Honigsmann here presents the results of a seven-week's stay in the trading post of Fort Nelson, gathering information from the Athabaskan Slave Indians by means of interpreters. This mass of detailed field data will be useful as source material for broader studies and possesses interest to specialists in this region. The orientation of the study is psychological and sociological. Some of the data will, therefore, also be of interest to psychologists and sociologists.

In the second part of this publication, Mason has assembled the field data that he gathered in 1913. As he explains in his preface, this was his only excursion into Athabaskan ethnology, and he has not kept up with that field but has diverted his interests elsewhere. These are only field-notes, made available to specialists in that field.

GEORGE F. CARTER



GRASSY ISLAND. *Archaeological and Botanical Investigations of an Indian Site in the Taunton River, Massachusetts. Papers of the Robert S. Peabody Foundation for Archaeology, Volume 1, Number 2.*

By Frederick Johnson and Hugh M. Raup. *Phillips Academy, Andover.* \$1.00 (paper). viii + 68 pp. + 3 plates; ill. 1947.

Grassy Island has long been known as an archeological site. It attracts particular interest because the habita-

tion level is beneath the present sea-level and is now covered with up to 5 feet of peat. This paper reports the results of a restudy of this site and of its implications, both cultural and chronological.

The report is unusual for its breadth and use of method. In addition to a standard treatment of artifacts, and relations of this culture to others in the region, it presents valuable evidence for a recent rise of sea-level, for the relation of a rising sea-level to the formation of peat, for the method of marsh-formation, the movement of islands, the effect of rising sea-level on the modification of meanders, etc. By relating the rise of sea-level to the thickness of peat, a tentative date is reached for abandonment of the site at about 1200 A.D. It is all too seldom that we find a slim, readable paper packed with so much interesting material. Too many papers are narrowly specialized. This one "ramifies" broadly, and its value is thereby greatly increased.

GEORGE F. CARTER



THE CANADIAN DAKOTA. *Anthropological Papers of The American Museum of Natural History, Volume 41: Part 1.*

By Wilson D. Wallis. *The American Museum of Natural History, New York.* \$2.50 (paper). 225 pp. 1947.

The material herein presented concerns the Wahepton band of the Dakota tribe, living at Portage La Prairie Reservation. This is essentially a presentation of raw data under topical headings. Gaps have been filled, when possible by using earlier reports on the Dakota. The information is organized under the topics: Material Culture; Political Organization; Social Life; Dance Societies; Medicinemen and Medicinewomen; Clowns. There is heavy emphasis on the last three topics.

The work is valuable for its presentation of data. Since discussion has been eschewed, it is left for other workers to give this data a wider meaning. Ethnologists, sociologists, and psychologists will find it a rich source of material bearing on primitive society.

GEORGE F. CARTER



PREHISTORIC INDIANS OF THE SOUTHWEST. *The Colorado Museum of Natural History Popular Series Number 7.*

By H. M. Wormington; appendix by Erik K. Reed. *The Colorado Museum of Natural History, Denver.* \$2.50 (cloth); \$1.50 (paper). 191 pp.; ill. 1947.

This small book compresses the archeology of the Southwest into 160 pages of text. It is written for the non-professional interested in the prehistory of the area. Consequently the discussion is kept as non-technical as

possible. Its coverage is comprehensive both as to time and area. It is useful for just the purpose intended. It is a good, sound, brief survey of what is known of the archeology of the area. Its only fault is that of so many such books; it is neither good enough for a scholarly work nor light and easy enough reading for a non-scholarly work. It falls just between the two and thereby limits its audience. Only those with very considerable intellectual interest will read through it. For them it will serve as an introduction to a greater field.

GEORGE F. CARTER



CAVES OF THE UPPER GILA AND HUECO AREAS IN NEW MEXICO AND TEXAS. *Papers of the Peabody Museum of American Archaeology and Ethnology, Volume XXIV—Number 2.*

By C. B. Cosgrove. *Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge.* \$6.25 (paper). xvi + 181 pp. + 55 plates. 1947.

Caves in the arid Southwest are storehouses of incredible amounts of the perishable materials left by the early peoples of that region. They are particularly important for the evidence that they yield concerning such peoples as the Basket Makers, predecessors of the Pueblo people. The origin of many Basket Maker traits is still a considerable problem, as is also the relationship of the remains found in caves over a wide area in the Southwest. This monograph presents the results of work done in one of the critical areas in order to answer some of these questions of origin and relationship.

The upper Gila and the Hueco areas lie between the classic Basket Maker areas of northern Arizona and southern Utah, on the one hand, and the area of the Cave Dwellers culture of the lower Pecos River and the Big Bend region of the Rio Grande, on the other. This area also lies athwart one of the possible routes of diffusion of traits from Mexico and Central America to the Southwest. It is this that gives the present report special value. Cosgrove considers the material reported on here to indicate a considerable relationship of its producers to the Basket Maker people, although it also shows considerable relationship to the Big Bend Cave Dwellers. This is about what one would expect from its geographical position.

Most unfortunately, this work was written up in 1934 shortly before Cosgrove's death. As a consequence, the very important evidence from the plant materials present in the collections has not been utilized. (The major advances in our ability to use domestic plants for the identification of cultures dates from 1940.) Even so the material reported and illustrated is of great interest. Some of the corn reported is many-rowed

and hence may be related to the early Basket Maker material of the San Juan.

The report is profusely illustrated, the materials are carefully described, and comparisons have been made with neighboring areas and related cultures. It is with deep regret that one realizes that there will be no more such work by this man.

GEORGE F. CARTER



SAN BLAS CUNA ACCULTURATION: AN INTRODUCTION. *Viking Fund Publications in Anthropology Number Nine.*

By D. B. Stout. *The Viking Fund, New York.* \$2.50 (paper). 124 pp. + 16 plates. 1947.

Material on the San Blas Cuna of the islands off Panama is here assembled. An unusually long record is available because of the early importance of Panama. The material from these early records is used to compare and contrast with the ethnology of the present-day Cuna, as recorded during a five-month's stay by the author. The report is concisely written and packed with facts.

Particular interest is attached to the processes of acculturation through the long period of contact. The Cuna are shown to have but recently moved to the islands. The shifts in their ways of life consequent upon this migration are numerous. They have always remained aloof from the negroes and the Spanish peoples. Recently they have become enamored of the Americans, and are striving for cultural identification with them. Values are shifting from their older emphasis on farming and fishing to work in town; from subsistence to cash trade for necessities, etc. Such studies are of great value, for the processes of acculturation and the attendant dislocations and cultural breakdowns are world-wide problems and seemingly will not only continue but will accelerate in the future.

GEORGE F. CARTER



INDIAN SKELETAL MATERIAL FROM THE CENTRAL COAST OF PERU. *Expeditions to Southern Peru, Peabody Museum, Harvard University, Report Number 4. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Volume XXVII—Number 4.*

By Marshall T. Newman, with a synopsis of the *Archaeology* by Gordon R. Willey. *Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge.* \$2.50 (paper). x + 72 pp. + 4 plates. 1947.

This detailed study attempts to analyse the ancient racial history of the Central Coast of Peru on the basis of much skeletal material from all four known cultural

periods of that area. The latter are discussed briefly in *A Synopsis of the Archaeology*, by G. R. Willey, which considers specially the sites from which the skeletons used here were recovered. A total of 231 skulls were available for craniometric examination; other skeletal parts were not measured, but were used in assessing age and for the study of the frequency of pathological conditions, which are surprisingly rare in this material. Artificial cranial deformation of marked degrees is prevalent in skulls from the earlier periods, but has nearly disappeared in those of the later ones.

The aboriginal Peruvian population under investigation shows only subracial variations. The various cranial series all indicate "a basic population of one racial stock which varies from period to period and valley to valley because of the amalgamation of outside racial elements and intra-valley genetic change. This basic racial group is characteristically short in stature, small vaulted, brachyranic, mostly high-headed, medium in facial proportions, below average in prognathism," etc.

A. H. SCHULTZ



THE ETHNOGEOGRAPHIC BOARD. *Smithsonian Miscellaneous Collections, Volume 107, Number 1. Publication 3889.*

By Wendell Clark Bennett. *Smithsonian Institution, Washington, D. C.* 65 cents (paper). viii + 135 pp. 1947.

The Ethnogeographic Board was set up in an effort to make the country's scholarly and scientific resources available for emergency use during the war. In the words of the author, this is "a historical account of the work, an appraisal of the experience, and constructive suggestions for the consideration of the Sponsors as to the most effective ways of organizing the scholarly and scientific resources, which they represent, for public service." The background of the problem that led to the founding of the Board, its organization, budget, and activities and projects are all presented. Future problems are discussed with special emphasis on problems of area experts, materials, reports, and training.

The Board served a useful purpose. Should an emergency again arise, this report would enable the rapid establishment of a similar organization.

GEORGE F. CARTER



AN AFRICAN ARISTOCRACY. *Rank Among the Swazi. A Publication of the International African Institute.*

By Hilda Kuiper. *Oxford University Press, London, New York, and Toronto.* \$8.00. xii + 252 pp. + 16 plates + 1 map. 1947.

The author has felt that an analysis of Swazi culture,

which she had studied for several years, would be most fruitful when revolving around the social structure of this South African kingdom, now a "protectorate." She gives the story of the conquest of the country by the now ruling clan of the Dlamini, and tells how two-thirds of Swaziland were stolen by the South African Dutch and English.

The economic foundations of Swazi society are those familiar from so many other excellent monographs on the Southern Bantu (by Junod and others): a primitive agriculture, depending upon a plurality of wives, "bought" with cattle. The fundamental political idea of these kingdoms—that the land belongs to and is mystically identified with the king—takes its special Swazi elaboration along the lines of a highly developed aristocracy and a dual monarchy (king and queen-mother). As a conquering kingdom, the Swazi stressed military organization in regiments formed by age groups. As in other African societies, it is impossible to overlook the strong similarities here with early medieval European feudalism in structure and attitudes; and the advantages that the British have derived from preserving medieval forms in their own political structure (king, queen-mother, etc.) when integrating such "primitive cultures."

The author has analysed in detail the weak and strong spots of Swazi political arrangements, and the reflection and reinforcement of the politico-social structure in religion and ritual. A great number of interesting data are reported clearly and intelligently. It is an excellent monograph.

ERWIN H. ACKERKNECHT



THE MOUNTAIN ARAPESH. *III. Socio-Economic Life; IV. Diary of Events in Aliioa. Anthropological Papers of The American Museum of Natural History, Volume 40, Part 3.*

By Margaret Mead. *The American Museum of Natural History, New York.* \$2.50 (paper). Pp. 159-420 + 4 plates. 1947.

These are the third and fourth issues of a series of very detailed anthropological studies dealing with the culture of the Arapesh people, who live in the mountains of the mandated Territory of New Guinea. The first paper (of 60 pages) describes the socio-economic life in this primitive society, dwelling chiefly on the complicated kinship systems and other social relationships and on the economic structure of the community, the work performed, the property owned and the rules concerning inheritance, payment for services rendered, feasts, etc., and, last but not least, the inter-relationships between these varied topics. The second and much longer paper is a novel attempt to picture minutely the actual, intimate behavior of these natives by means of a diary accounting fully for stage-setting, actors, and

play in a half-year's life of a small group of these aborigines. No event or circumstance seems too trivial for this faithful, patient portrayal of human existence at a low level of cultural development. Every quarrel, illness, infidelity, marriage, sorcery, etc., is recorded, and the reaction of the people to them is noted. Altogether this forms a valuable, comprehensive record of anthropological observations, particularly welcome for later comparative studies. The present report contains no summary and no general conclusions.

A. H. SCHULTZ



ACRES AND PEOPLE. *The Eternal Problem of China and India.*

By Earley Vernon Wilcox. Orange Judd Publishing Company, New York. \$3.00. 297 pp.; ill. 1947.

From personal observation and wide consultation of standard works, the author of *Acres and People* has learned enough about the Orient to write a good, but scarcely original, study of the population problems of India and China. In his comparisons of the two peoples, he is rather overly impressed by the more favorable status of the Chinese, whom he regards as better off in nearly every way. Consequently, although he probably does not exaggerate the difficulties of India's food and population problem, he seems to make light of that which faces the Chinese. The book ends with a wholehearted outburst of admiration for the Filipinos.

Many parts of the book seem to have been written before or early during the war. The lengthy discussions of political matters date back to a time when in India the Cripps proposals were new and in China the great westward migration ahead of the Japanese had just begun. Why such a book should be published in 1947, without extensive revision, is indeed a mystery.

BENTLEY GLASS



EUROPE'S POPULATION IN THE INTERWAR YEARS. *Series of League of Nation Publications. II. Economic and Financial 1946. II. A. 8.*

By Dudley Kirk. *Economic, Financial and Transit Department, League of Nations, Geneva; Columbia University Press, New York.* xii + 307 pp. + 8 maps; ill. 1946.

This book will be warmly welcomed by biologists and other citizens who have felt vexed by the propensity of *Homo sapiens* to conduct his affairs within the more or less watertight compartments of national states and by the resulting difficulty of studying these affairs in terms of larger geographical units. Using as his main sources the census and vital statistics of the period between the First and Second World Wars, Dudley Kirk has pre-

sented us with a demographic analysis, not of a series of countries, but of a continent as a whole. Wherever possible, data are shown for some six hundred administrative districts, a procedure which throws into relief important patterns often obscured by the use of national averages.

After a brief introduction, three chapters deal with population distribution and population change and with the biological factors that determine the direction and rate of change, fertility and mortality. The next four chapters are devoted to migration—overseas, international within Europe, and internal—and its role in population growth. The ninth chapter presents the continental patterns in the fields of health, literacy, occupational structure, and agricultural productivity. This is followed by a discussion of ethnic diversity and language. In the concluding chapter the demographic situation of Europe is analysed in relation to the world as a whole. Author and publisher have managed to keep their book readable by excluding the bulk of statistical tables from the main body of the text. They are presented in a number of very useful appendices. Much of this information is not readily available anywhere else, and for any scholar to reassemble it would require years of work. Ample use has been made of diagrams and maps which are a pleasure to behold.

CHRISTOPHER TIETZE



SOCIALITY IN PREADOLESCENT BOYS. *Teachers College, Columbia University Contributions to Education, Number 918.*

By Ruth Edith Hartley. Bureau of Publications, Teachers College, Columbia University, New York. \$1.85. viii + 117 pp. 1946.

This study reports a research project on the measurement of sociality in preadolescent boys, the reliability and validity of the measures, and the interrelationships among them. Two aspects of sociality were studied: (1) *extensity*, indicating the number of different people toward whom the individual has positive social relations and (2) *intensity*, the intensity of these relations. Several tests of each aspect were studied. Individual tests are reasonably reliable, but the low correlation between various tests does not confirm the existence of two such factors of sociality. Measures of extensity and intensity are not highly correlated. The tests as a group can probably differentiate groups of highly sociable children from those who are unsociable—if they are selected by skilled judges—but several of the individual tests do not discriminate significantly. The analysis of the meaning of the pattern of test scores in individual cases suggests some very interesting interpretations of the scores, but further validation will be required to establish the meaning of such patterns.

ALFRED L. BALDWIN

MAN AND OTHER LIVING THINGS: *An Introduction to Human Biology.*

By Francis G. W. Knowles. George G. Harrap & Company, London. 10s. 6d. 355 pp. + 32 plates. 1945.

There are so many extraordinarily fine things about this British textbook of biology for secondary school students that only a few can be enumerated. Suffice it to say that every aspect of biology is well taken care of, in an interesting and accurate fashion, not too attenuated nor over-difficult for the sub-college level. The book begins with a study of the house-fly as a representative animal and the buttercup as a representative plant, and goes on to take up the composition of living things, classification, plant and animal nutrition, respiration, transport, movement and support, excretion, the nervous system, hormones and glands, growth and size, and reproduction, including the human. The Invention of the Microscope is a chapter typical of the emphasis laid on the development of biological knowledge, and this is also seen in the discussion of bacteria and viruses that follows. The protozoa and algae, the fungi, symbiotic and social life, and biological control form a unit that is followed by several chapters on evolution and a final discussion about heredity. There is a good selection of books for further reading, a section of experiments and observations planned to accompany each chapter, and an index. The illustrations, particularly the full-page, beautifully reproduced halftones, are outstanding. Accuracy in all respects is characteristic. The slenderness of the volume contrasts sharply with our over-stuffed American products. In short, it is clear that the great tradition of popular biology teaching and writing that stemmed from T. H. Huxley to J. A. Thomson, Wells, Huxley, and Wells, and Lancelot Hogben continues to bear worthy fruit.

BENTLEY GLASS



THE MARRIAGE READER: *A Guide to Sex Satisfaction and Happiness in Marriage.*

Edited by Samuel G. Kling and Esther B. Kling. The Vanguard Press, New York. \$3.00. xii + 489 pp. 1947.

This anthology on marriage contains a wide variety of good and bad, with the former exceeding the latter by a comfortable margin. Sage and sociologist offer advice freely on sexual adjustment and sterility. To marry early or to marry late, to marry like or to marry unlike, to marry with romantic love or without romantic love, to have children or to adopt children, to sleep in a single bed or in twin beds or in separate rooms—these and many other crucial questions of marital adjustment are carefully considered. A galaxy of seers—Balzac and Benjamin Franklin, Havelock Ellis, Eleanor

Roosevelt, and Bertrand Russell, Alfred Adler and André Maurois, and, of course, Margaret Sanger, Marie Stopes, and Hannah Stone—mingle with less well-known contributors who may speak their views less ardently but with more scientific caution: Henry Bowman, sociologist, talks plain common sense on the difficulties of making the necessary adjustments in Mixed Marriages of any sort, nationality, religion, age, intelligence, economic status; Millard S. Everett comments sensibly on Romantic Love, and is matter-of-fact about the Anatomy and Physiology of Sex; Evelyn M. Duvall and Reuben Hill are excellent on What Holds a Marriage Together.

The editors have really done a fair job of selection from the oceans of literature on sex and marital adjustment, with only an occasional obvious lapse, such as the inclusion of a selection on The Hygiene of Pregnancy (W. J. Fielding) that not only bears the marks of its age (22 years) but was filled with appalling biological errors even at the time of its conception. This is definitely not a book for the biologist; but the general public, for which it has been compiled, may look farther and fare worse.

BENTLEY GLASS



BIOMETRY

MÉTHODES STATISTIQUES EN MÉDECINE ET EN BIOLOGIE.

By E. Morice, with the collaboration of M. Tisserand and J. Reboul; preface by A. Baudouin. Masson et Cie., Paris. 480 fr. (paper). xx + 182 pp.; ill. 1947.

This is a textbook on elementary statistical methods. As its title implies, the examples and illustrations are drawn from the fields of biology and medicine. The simpler descriptive statistics receive adequate coverage; but the sampling statistics are treated less thoroughly and are confined to the standard error of the mean, the t-test for significance between means, and the significance of percentages and correlation coefficients. Although limited in comprehensiveness, this treatment should still enable the researcher to handle a great variety of problems.

In addition to these conventional topics, there is a good chapter on statistical charts. It discusses Cartesian-coordinate and polar-coordinate charts, bar diagrams, sector charts, cartograms, three-dimensional charts, and logarithmic scales. This topic is all too often neglected in elementary statistics, and the discussion here should be very useful in showing the student how to present statistical data graphically. There is also a good chapter on the collection of statistical data. It begins with a point of view which the reviewer feels cannot be over-emphasized: Statistics are a tool; they are no better than the original data.

The authors' approach to correlation as an analysis-of-variance problem is unusual for an elementary text. Since the reviewer feels that this is a reasonable way to teach correlational methods, he cannot help but endorse the authors' approach. Also noteworthy are the graphical "abacuses" for showing the significance of chi-square, t , and r , and the z transformation of r . Although slightly less accurate than tables, these abacs are much simpler to use in problems which require interpolation, as most do.

All in all, this is a sound book, well-written, and easy to follow. The foreign language, however, will undoubtedly limit its usefulness for students in this country.

A. CHAPANIS



SELECTED TECHNIQUES OF STATISTICAL ANALYSIS for *Scientific and Industrial Research and Production and Management Engineering*.

By the Statistical Research Group, Columbia University; edited by Churchill Eisenhart, Millard W. Haslay and W. Allen Wallis. McGraw-Hill Book Company, New York and London. \$6.00. xiv + 473 pp. + 1 chart; ill. 1947.

During the war, the Statistical Research Group at Columbia University advised and assisted the Army, Navy, and Office of Scientific Research and Development on the statistical aspects of problems arising in their activities. It was almost inevitable that in the course of this work the group would encounter some problems which required the elaboration and development of certain specialized statistical techniques. This book is a compendium of those statistical developments which were by-products, as it were, of the solutions to practical military, scientific, engineering, and production problems.

The book contains 17 chapters, each written by one or more members of the group. The material falls into three parts: I. Industrial Statistics; II. Planning Experiments; and III. Techniques and Tables. Because of its origin, this is not an integrated textbook on statistics. It is rather a series of fairly intensive studies of selected statistical methods.

As compared with other texts in this field, this one is at a medium level of difficulty. It appears to be suitable for those readers who already have some understanding of elementary descriptive and sampling statistics. Most of the topics discussed are oriented toward industrial or engineering problems, but the biometrist should find a few items of interest among them. The inverse sine transformation of proportions—which was first introduced by way of theoretical genetics—receives a fairly detailed discussion, for example. There is an excellent chapter on the Effects of Rounding or Grouping Data, and there are several

other good ones on planning efficient experiments for estimating or comparing certain statistics.

This is the kind of book which the professional statistician or biometrician will probably want to have. The ordinary research worker, however, is likely to find it of little use.

A. CHAPANIS



DE OMNIBUS REBUS ET QUIBUSDEM ALIIS

RESEARCH: *A Journal of Science and its Application*. Volume I, Numbers 1 and 2, October and November, 1947. Monthly.

Edited by P. Rosbaud and D. R. Rexworthy. Butterworths Scientific Publications, London. Annual subscription, £2 5s.; \$10.00.

The laudable aims of the new journal *Research* are to provide the technical specialist with an idea of what is going on in other fields than his own, and to assist the pure scientist to realize what an enormous amount of industrial research must go on before a new scientific discovery can find its way into practical applications. The contents, judging from the second issue, will fall chiefly in the realm of the physical sciences, but not altogether. There is an article of biological interest, on Science in Whaling, by C. E. Ash, in this issue. Important biological books will also be reviewed.



SCIENCE NEWS—4, 5.

Edited by John Enogat. Penguin Books, West Drayton, Middlesex. 1s. each (paper). (4) 171 pp. + 16 plates; text ill.; (5) 168 pp. + 16 plates; text ill. 1947.

Number 4 includes popular biological articles on the following subjects: Life at High Pressures (J. B. S. Haldane); Medical News; The Control of Flowering (E. Ashby).

Number 5 includes: Physical Treatment of Mental Illness (A. Lewis); Cave Science (M. Pavan); Biochemical Aspects of the Soil (J. H. Quastel); The Common Cold; Medical Front (J. Enogat); How Messages are Transmitted Along Nerves (W. A. H. Rushton).



MIDDLE EAST SCIENCE: *A Survey of Subjects Other Than Agriculture. A Report to the Director General Middle East Supply Centre, August 1945.*

By E. B. Worthington. His Majesty's Stationery Office, London. \$1.60. xiv + 239 pp. + 16 plates + 2 maps. 1946.

Scientific problems and resources in the Middle East are, on the whole, poorly understood and little appreciated except by those who have a special interest in

that area. When, with the advent of the war, the Middle East Supply Centre was established by the British to ensure the civil populations in the Middle East countries those supplies which were essential for their livelihood in wartime, the need for expert scientific study soon became evident. This book is a report of such a scientific survey. The area covered consists of Egypt, the Sudan, Palestine, Transjordan, Lebanon, Syria, Iraq, Cyprus, Persia, Arabia (in entirety), Ethiopia, Eritrea, the Somalilands, Cyrenaica, Tripolitania, and Malta. The survey considers basic problems of living, land surveys, geology, meteorology, rivers and underground water, plants, animals, forestry, marine and inland fisheries, human diseases, health and medical service, and population and social studies. Maps and fine photographs are included. This report is especially valuable in bringing together references to most of the important and frequently obscure scientific literature pertaining to the area and in pointing out the many lacunae in our knowledge.

V. G. DETHIER



AWAY FROM THE HERE AND NOW. *Stories in Pseudo-Science.*

By Clare Winger Harris. Dorrance & Company, Philadelphia. \$2.50. 365 pp. 1947.

Having been informed by a recent magazine article that some of the greatest living scientists,—including a Nobel Prize winner or two,—are addicted to “science fiction,” Percy, our new office boy, told us we ought to look some of these stories over. “What’s the use of reading these ‘Recent Advances’ in this and that,” he asked, “when the fiction writers have already got it doped out for the next century, anyway?” So we have

read some of those stories, and are now practically convinced. At least we haven’t been able to sleep so soundly since peering into the future. Take Clare Harris, now. She hasn’t the style of William Morton Wheeler or William Beebe; but her narrative, unhampered by grammatical niceties, or the need to portray characters with psychological penetration, moves at a pace rather bewildering to one so long accustomed to the biological reviews. There is enough science in the back-ground to make these stories of interplanetary travels, war with insects, men with artificial organs, speeded up evolution, and apes bred for intelligent servitude to man have a ring of plausibility. Some of them might, in fact, be regarded as extrapolations of the soberer predictions of Jean Rostand, Harry Shapiro, and others. All in all, it is rather like seeing yourself in one of the distorting mirrors at Coney Island.



INTERTONGUING MARINE AND NONMARINE UPPER CRETACEOUS DEPOSITS OF NEW MEXICO, ARIZONA, AND SOUTHWESTERN COLORADO. *The Geological Society of America. Memoir 24.*

By William S. Pike, Jr. *The Geological Society of America, New York.* \$2.25. x + 103 pp. + 9 plates + 1 chart; text ill. 1947.

A LIST AND INDEX OF THE PUBLICATIONS OF THE UNITED STATES NATIONAL MUSEUM (1875–1946). *Smithsonian Institution, United States National Museum, Bulletin 193.*

Compiled in the Editorial Division, Smithsonian Institution. *United States Government Printing Office, Washington, D. C.* \$1.00 (paper). iv + 306 pp. 1947.

THE QUARTERLY REVIEW of BIOLOGY



THE MECHANISM OF ENZYMATIC OXIDATIONS AND REDUCTIONS

By JAMES E. LUVALLE AND DAVID R. GODDARD

Eastman Kodak Company, Rochester, N. Y. and Department of Botany, University of Pennsylvania

I. INTRODUCTION

THE investigations of the last two decades have added greatly to our knowledge of the chemical nature of the enzymes of oxidation-reduction and their physiological roles in cellular metabolism. This subject has been reviewed elsewhere by Oppenheimer and Stern (1939), Green (1940), Sumner and Somers (1947), Kalckar (1941), and Goddard (1945), and will be only incidentally dealt with in this article.

This paper is an attempt to present a unified treatment of the mechanism of a diversity of enzymatic oxidation-reductions and the pertinent kinetic relationships. A few basic assumptions are used as the foundation for the treatment:

1. The enzymes of oxidation-reduction are conjugated proteins with a prosthetic group or simple proteins acting with organic co-enzymes.
2. Every enzyme of oxidation-reduction has two substrates, an electron donor and an electron acceptor.
3. The enzymes are active partners in the mechanism of the reactions, but the cyclical nature of the reactions returns the enzyme to its original state. That is, they are true catalysts.
4. An enzyme may itself be a substrate for another enzyme.

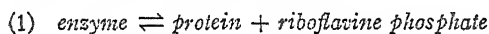
5. A trimolecular complex is formed between the enzyme, the acceptor, and the donor, in two bimolecular reactions.
6. Electron transfer in univalent steps constitutes the oxidation, and hydrogen transfer occurs through the solvent by ionic association and dissociation.
7. The catalysis occurs within the acceptor-enzyme-donor ternary complex by univalent electron transfer. This results in the formation of free radicals (or semiquinones) of enzyme-donor, enzyme-acceptor, or acceptor-enzyme-donor. We consider it improbable that free radicals in the solvent play an appreciable role in cellular metabolism.
8. The concepts of oxygen activation and chain reactions are not only unnecessary but are impossible, if the high specificity which enzymes show is to be retained.
9. The kinetics of enzymatic reactions can be explained in terms of the rates of formation of the binary complexes and perhaps of the ternary complex.

Many of these assumptions are not original with us, but we do not know of any treatment where they have all been made and where the conclusions have been drawn which follow from these assumptions.

After attempting to justify these assumptions, we shall use them as a basis for a kinetic treatment

of the enzymatic oxidations. Further, the Michaelis-Menton theory which was developed for an enzyme and one substrate will be extended to include the cases of two substrates.

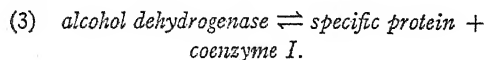
Many of the enzymes of oxidation-reduction have been obtained in essentially pure form (see the citations in the opening paragraph), and all so isolated have been proteins. For example, catalase (Sumner and Dounce, 1937, 1939, 1941) and peroxidase (Theorell, 1943a) are heme proteins containing the same heme as hemoglobin; here the specificity would seem to be determined by the protein. Several are flavoproteins containing as the prosthetic group either riboflavine phosphate or adenine-flavine-dinucleotides. In the case of the heme enzymes, the heme is so firmly attached that, under physiological conditions, it cannot be demonstrated that the enzyme dissociates. In the case of a flavoprotein, such as cytochrome reductase, the dissociation has been measured by Haas and coworkers (1940, 1942), and may be represented as follows:



$$(2) \frac{(\text{riboflavine phosphate})(\text{protein})}{(\text{enzyme})} = K_e$$

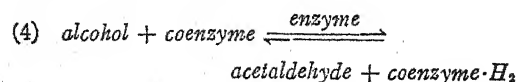
where K_e = dissociation constant, and for this case has the value of $10^{-9}M$.

Many of the dehydrogenases are active in the presence of either coenzyme I (cozymase, or diphosphopyridine nucleotide) or II, and others only in the presence of coenzyme II (triphosphopyridine nucleotide). Warburg (1938) has considered that these coenzymes are the prosthetic groups of enzymes which dissociate as follows:



The dissociation constants have been measured by Negelein and Wulff (1937b) for the coenzyme and reduced coenzyme, and were $9.5 \times 10^{-5}M$ and $3.2 \times 10^{-5}M$, respectively.

There is, however, an alternate interpretation in reference to the dehydrogenases. We might consider the specific protein as the enzyme and the coenzyme as the substrate, and, following Dixon and Zervas (1940), represent the conditions as shown in reaction (4):

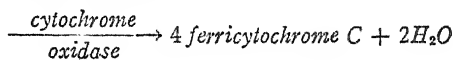
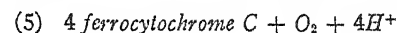


in which we consider the specific protein as an

enzyme catalyzing a bimolecular reaction between substrate and coenzyme. The enzyme is not entirely specific for the coenzyme, since the latter may be replaced by an alloxan (Dixon and Zervas, 1940); so there is good reason to consider the coenzyme as an enzyme substrate and not as a prosthetic group.

One may postulate two substrates for the enzymes of oxidation solely on the theoretical ground that every oxidation requires an equivalent reduction. There is, however, an abundance of experimental evidence for the necessity of two substrates. The enzyme peroxidase does not decompose hydrogen peroxide unless a suitable electron donor is also present. The oxidases which function with molecular oxygen as electron acceptors are inactive except in the presence of a specific electron donor.

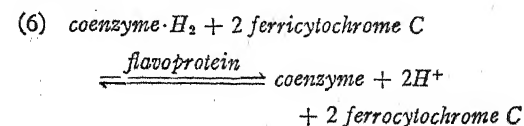
The specificity may be complete, that is, when only a single electron acceptor and a single electron donor are known; or several acceptors or donors may be active with a single enzyme. For example, cytochrome oxidase (Keilin and Hartree, 1939a) is an enzyme which is known to react only with one electron acceptor, oxygen, and a single electron donor, the heme protein, cytochrome C:



Net change: Four electrons donated by four ferrocytochrome C molecules and accepted by an oxygen molecule; four H^+ donated by environment to form $2H_2O$.

A particularly interesting case is that of catalase, which decomposes hydrogen peroxide. Here, a single substrate appears adequate, but we propose that catalase acts on two molecules of hydrogen peroxide simultaneously through the formation of a trimolecular complex of H_2O_2 -enzyme- H_2O_2 .

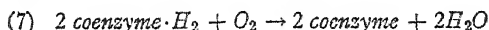
The enzymes of oxidation-reduction may actually undergo chemical change during the course of the reaction. For example, the reaction between coenzyme II (triphosphopyridine nucleotide) and cytochrome C or methylene blue is catalyzed by a flavoprotein named cytochrome reductase (Haas et al., 1940, 1942):



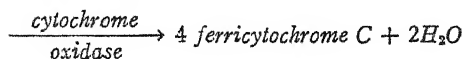
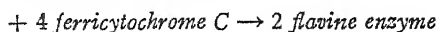
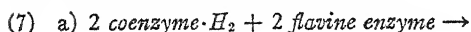
Net change: Two electrons donated by ferri-cytochrome C and accepted by leuco-coenzyme, with the corresponding liberation of two H^+ .

If the mechanism of catalysis is examined by adding leuco-coenzyme to the flavoprotein in the absence of cytochrome C, it is found that the flavoprotein is rapidly reduced to its leuco form in a two-electron reduction, probably by way of two univalent steps with a semiquinone (free radical) of the enzyme as an intermediate. If cytochrome C is now added in the absence of cytochrome oxidase, the cytochrome C is reduced and the leuco flavoprotein reoxidized. In this reaction cytochrome C is reduced from ferri- to ferrocytochrome with a single electron change (Hill and Keilin, 1933). Several reactions of this type are known where the enzyme changes its valence state during reaction.

This actual participation of the enzymes in the reaction with a change of valence of the enzyme in a cyclical manner raises the question of whether an enzyme undergoing chemical change in a reaction is a perfect catalyst. That is, are the equilibrium points uninfluenced by the concentration of the enzymes and the valence state of the enzyme? If, for example, we consider the reaction:



we find that this reaction is catalyzed by an enzyme system of at least three enzymes, flavine enzyme, cytochrome C, and cytochrome oxidase.



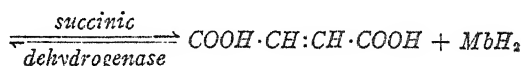
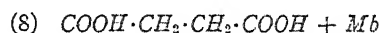
It is obvious that (7a), (7b), and (7c) are an oversimplification, since none of these reactions will be more than bimolecular. It is also clear that the enzyme is returned to its initial state in a second reaction, so that, in the over-all reaction, if we consider only electron donor and acceptor, the enzyme will not appear in the stoichiometric

equation. It is clear, however, that in a closed system with a finite amount of oxygen and coenzyme the equilibrium will not be independent of the concentration of any enzyme undergoing chemical change during the reaction, or of the valence state of the enzyme at the time of its addition.

In practice, we have an unlimited reservoir of oxygen, the whole atmosphere, and because of this the equilibrium is essentially independent of the enzyme concentration or its initial state of oxidation.

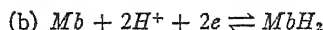
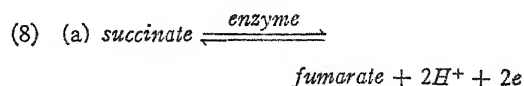
In the living cell not only is the oxygen replaced as it is used, but new substrate constantly enters the enzyme system. In fact, except in the study of death, the cellular physiologist is normally concerned with kinetic steady states and not with equilibria.

Some examples of thermodynamically reversible systems catalyzed by enzymes are known. The reaction between the dye, methylene blue, and succinic acid to form fumaric acid and the leuco dye is catalyzed by the widely distributed enzyme, succinic dehydrogenase, as shown in equation (8):



Net change: Two electrons donated by succinic acid and accepted by methylene blue accompanied by the dissociation of two hydrogen ions from succinic acid and the association of two hydrogen ions by methylene blue.

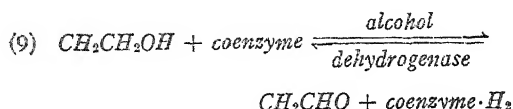
Reaction (8) may be written as proceeding in steps:



Reaction (8b) is known to be reversible from potentiometric measurements. From the equilibrium constant calculated from thermal data of reaction (8a), and the observed potentials of reaction (8) in the presence of small amounts of dye as compared to the amount of fumarate and succinate, thermodynamic reversibility has been demonstrated (Borsook and Schott, 1931a, b).

One of the best-studied systems from the point

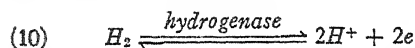
of view of reversibility is the acetaldehyde-alcohol system:



Net change: Two electrons donated by ethanol, two electrons accepted by the coenzyme, two H^+ donated by ethanol, two H^+ accepted by the coenzyme.

This reaction, which was studied by Negelein and Wulff (1937b), may be catalyzed by a crystalline protein enzyme and the equilibrium followed by the difference in light absorption at 3400 Å of the oxidized and reduced coenzyme I (diphosphopyridine nucleotide). The enzyme appears to act as a reversible catalyst, although strict proof of thermodynamic reversibility has not been established.

Studies of the hydrogenase of bacteria by Green and Strickland (1934), as shown in reaction (10),



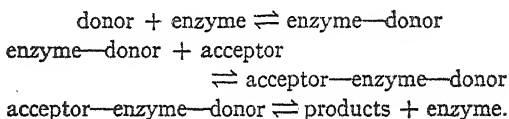
have shown that the same equilibrium is reached with the enzyme as with platinum black.

The fact that many enzymes actually undergo a valence change during reaction does not justify the generalization made by Goddard (1945) that all enzymes of oxidation-reduction change their valence state during reaction. If certain dehydrogenases are simple proteins (Dixon and Zervas, 1940), there is no reason to expect that the protein is measurably oxidized or reduced during the reaction. The heme enzyme, peroxidase, appears to remain as ferri-protein (Theorell, 1942b) throughout the catalytic cycle when H_2O_2 is the electron acceptor, though it would appear to undergo reduction within the cell.

Depending on how the system is defined or which partial reaction is studied, a single substance may be an enzyme or a substrate. For example, in reaction (5), cytochrome C is substrate for cytochrome oxidase. In the absence of a substance acting as an electron donor for cytochrome C, the rate of the oxidation may be followed by the rate of change in light absorption at 5500 Å, a wave length at which ferro and ferricytochrome C have different extinction coefficients. We find that, in the oxidation of ascorbic acid, hydroquinone, or cysteine by molecular

oxygen in the presence of cytochrome oxidase, cytochrome C functions catalytically (Keilin and Hartree, 1936, 1939a). An examination of the partial reactions will show that every catalyst which itself undergoes a valence change during catalysis must be a substrate in another reaction.

We propose that in enzymatic oxidations a new pathway of reaction between electron acceptor and donor is formed through a trimolecular complex of acceptor-enzyme-donor. The activation energy of electron transfer in univalent steps in the complex may be considerably lower than in the uncatalyzed reaction. We suggest that the rate of reaction in the tricomplex is not rate-limiting but that the rate-determining step is the formation of either the binary complex or the ternary complex, or the rate of decomposition of the ternary complex. One of the following reactions will then determine the over-all rate:



This concept of an intermediate complex of enzyme and a single substrate is old, for it was proposed by Henri (1903). Michaelis and Menton (1913) developed and extended Henri's concept and furnished experimental methods of determining the constants of formation of the intermediate. There is little direct experimental evidence for the existence of such intermediate complexes, for a catalytic complex would be expected to have a short half-life. However, the concept is consistent with the modern concept of chemical kinetics, as developed by Eyring and his associates (see Glasstone, Laidler, and Eyring, 1941), and with considerable kinetic data on enzymatic reactions. Stern (1936) was able to show by spectrophotometric means the existence of an intermediate compound between ethyl hydroperoxide and the enzyme catalase. Where a ternary complex is the intermediate, it should be possible to demonstrate the existence of at least one of the binary complexes in solution. It may be that the order is predetermined; for example, we suspect that oxygen reacts with the oxidases only after the formation of the donor-enzyme complex. The enzyme peroxidase has two substrates, H_2O_2 and an electron donor. Keilin and Mann (1937), Theorell (1942b), and Chance (1943a) have demonstrated a fairly stable complex between H_2O_2 and peroxi-

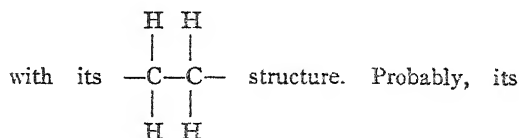
dase in the absence of an electron donor. Here, one molecule of H_2O_2 unites with the heme of peroxidase, with a shift in the absorption spectrum from a 4-banded spectrum at 6400 Å, 5830 Å, 5480 Å and 4780 Å to a 2-banded spectrum at 5610 Å and 5300 Å (Keilin and Mann, 1937).

The idea of a ternary complex is not new. It was proposed by Mann (1931), and Wolf (1931) suggested that after formation of the complex a series of tautomeric changes in the complex comprise the reaction.

Though there is no observational evidence for the ternary complex, there are voluminous kinetic data best interpreted by this assumption; for example, Chance's (1943a, b) work on H_2O_2 , peroxidase, and ascorbic acid; the work of Stotz, Altschul, and Hogness (1938) on O_2 , cytochrome oxidase, and cytochrome C; and the work of Haas, Hogness, and co-workers (1940, 1942) on cytochrome, flavoprotein, and coenzyme II. LuValle and Weissberger (1948) have shown that a ternary complex is necessary to explain heavy-metal catalysis of some autoxidation reactions. Michaelis (1929, 1940) and Schubert (1932) have proposed a ternary complex of cysteine, iron, and oxygen, in the iron catalysis of the oxidation of cysteine. Michaelis (1946) has proposed the same ternary complex for enzymatic reactions: "Let us suppose that the enzyme can combine not only with the substrate to be oxidized but also with the oxidizing agent. For example, methylene blue can oxidize succinic acid to fumaric acid in the presence of the enzyme called succinodehydrogenase. Suppose this enzyme can combine with both succinic acid and methylene blue. The specific structure of the enzyme brings about a definite spatial orientation and juxtaposition of fumaric acid and methylene blue. When a molecule of one of these two substances collides with a molecule of the other in a solution, the chance of an electron transfer during the short time of collision is nil; but when these two molecules are held close together in appropriate juxtaposition and orientation with respect to each other, they remain in this spatial arrangement for a long time, during which an electron transfer may occur once in a while. Now, the transfer of a single electron establishes the free radical, and from here on the second step of oxidation takes place readily and spontaneously."

Although a physical juxtaposition of the two substrates may take place, we do not believe that it is a necessary condition for oxidative-reductive

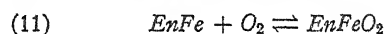
processes. It is necessary, however, that the donor and acceptor sites be connected via a mobile electron system, i.e., a resonating system, or a metal atom, or both. One difficulty is how a resonating structure can be set up between enzyme and substrate for a substance, such as succinate,



structure is markedly changed by combination with the enzyme. Potter and Dubois (1943, 1944) have cited evidence that electron transmission occurs between the succinate and cytochrome C sites of succinate dehydrogenase. It has also been demonstrated by Atkin (1944) that "malonate interferes with the donor enzyme function but not with the enzyme-acceptor function, which were therefore considered to be located at different points on the enzymes."

The Nature of the Bonds between Enzyme and Substrate

The type of bond between the enzyme and the substrate has long been of interest. Warburg (1926) early suggested that oxygen combined with the iron of cytochrome oxidase:

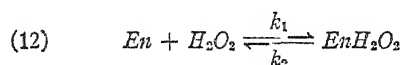


This idea was based on an analogy with hemoglobin, because the activity of the enzyme was inhibited by CO, HCN, and H_2S , and these substances were known to form compounds with ferro- or ferrihemoglobin. The inhibitory effect of CO was competitive—it depended not upon the partial pressure of CO alone but upon the ratio of O_2/CO . Further, the CO inhibition was reversed by light—as CO-hemoglobin is dissociated by light. All of these reactions constitute strong but not convincing evidence.

Peroxidase, catalase, cytochrome oxidase, and the cytochromes are all heme proteins, and in this they are analogous to hemoglobin. On the other hand, each of these heme enzymes differs from all the others and from hemoglobin in its physiological function. Hemoglobin is an oxygen-carrier, whereas the others are enzymes. In hemoglobin, the oxygen is carried by covalent bonding to the iron atom of the heme. The evidence that the heme enzymes bond their respective substrates to

the iron is inconclusive. In fact, there are very few direct data pertaining to the bonds between enzyme and substrate. But in the case of the heme enzymes there are some data upon the valence state of the iron atoms within the heme. Theorell (1942b) has suggested that the groups bound to the fifth and sometimes even the sixth places of coordination are those which most strongly contribute towards the differentiation in the mode of functioning of the iron atom.

Peroxidase is a particularly interesting example, for Theorell (1943a, b) has shown that the enzyme is a crystalline protein having a molecular weight of 44,100 and containing one heme and one iron atom per molecule. Theorell's magnetic studies (1942b) indicate that the iron is bound ionically with five odd electrons. The addition of H_2O_2 in the absence of an oxidizable substrate causes a shift in the absorption spectrum, and at low concentrations of H_2O_2 a molecular complex of one H_2O_2 per enzyme molecule is rapidly formed. The velocity of formation has been determined by Chance (1943a). The bimolecular reaction constant, k_1 , is 1.2×10^7 liter mole⁻¹ second⁻¹, and the monomolecular back reaction constant, k_2 , is 0.2 second⁻¹ or less, where



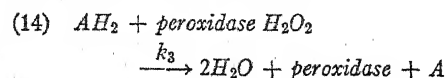
The equilibrium constant of dissociation of the complex was estimated, since

$$(13) \quad K_m = \frac{k_1}{k_2} = 2 \times 10^{-2}$$

indicating a very tight union of peroxidase and hydrogen peroxide.

The magnetometric studies of Theorell (1942b) indicate that the iron in the peroxidase- H_2O_2 compound is ionic and that it forms a stable compound with cyanide, one molecule of cyanide reacting per enzyme molecule. Theorell and Paul (1944) have shown that the groups bound in the fifth and sixth coordination places of iron determine its activity in peroxidases.

The nature of the trimolecular complex between H_2O_2 , peroxidase, and acceptor is not known, but it *must have a very short half-life*, as k_3 of equation



is 3.0×10^5 liter mole⁻¹ second⁻¹ when leuco mala-

chite green is the electron donor and 1.8×10^5 liter mole⁻¹ second⁻¹ when l-ascorbic acid is the electron donor.

Catalase has been isolated as a crystalline heme protein by Sumner and Dounce (1937, 1939), and shown to have a molecular weight of about 225,000 by Sumner and Gralen (1938). It probably contains three hemes per molecule, and a fourth iron atom not linked in the heme. Magnetometric studies of Theorell and Agner (1943) indicate that all of the iron is ionically bound with five odd electrons; and magnetometric titrations with HCN show that saturation with HCN occurs when three Fe atoms combine with HCN. Catalase forms a complex with ethyl hydrogen peroxide, accompanied by a shift in the absorption spectrum (Stern, 1936). The compound with H_2O_2 is of such short life that its presence has never been demonstrated; however, catalase forms in nitrogen a fairly stable compound with sodium azide and H_2O_2 . Azide is known as a powerful inhibitor of catalase (Keilin and Hartree, 1938, 1945a). It may be seen that azide does not prevent the formation of a complex with H_2O_2 , but it may prevent the formation of the catalytic ternary complex. From Theorell and Agner's (1943) magnetic studies, it appears probable that in azide-catalase- H_2O_2 , the iron is bound covalently.

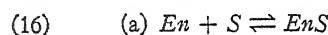
Cytochrome functions by alternate oxidation and reduction from the ferri- to the ferro-form, but under physiological conditions it does not form compounds with NaCN, CO, NaF, H_2O_2 , O_2 , all of which form compounds with either ferro- or ferri-hemoglobin. The iron atom appears to be bound by six covalent bonds (Theorell, 1943b), four bonds to the nitrogen atoms of the pyrrole rings and two to the imidazole rings of the histidine of the protein. The magnetic susceptibility indicates but one odd electron. Although no coordination places are thus available for union with O_2 or other substances, cytochrome does form complexes with its oxidase and with cytochrome reductase, so that electrons may be transferred from one to the other, with the dissociation of hydrogen ion to the medium.

As cytochrome C undergoes only a univalent oxidation-reduction, both cytochrome oxidase and cytochrome reductase must be capable of existence as enzyme semiquinones. Haas (1937) has given definite experimental evidence for the semiquinone of the reductase.

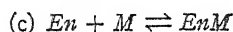
The nature of the bonding between dehydro-

genase and the substrate is of real interest, but little concrete information is available. In several cases (Barron and Singer, 1945) the enzyme is active as a sulfhydryl protein, and is inactive if the SH group is oxidized or substituted. The specificity is usually very high, and compounds of closely related structure often give competitive inhibition, for example, succinic dehydrogenase is inhibited by malonic acid: $\text{HOOC} \cdot \text{CH}_2 \cdot \text{COOH}$. The inhibition depends upon the ratio of malonic to succinic acid, and not upon the concentration of malonic acid alone (Quastel and Whetham, 1924). Potter and DuBois (1943) have studied the inhibition, using succinic acid at M/15, M/20, and M/30 and malonic acid at M/300, M/100, and M/3000; in all, nine combinations were used, and from their results the following calculations may be made:

If malonate and succinate combine with the same enzyme, at any instant the following relations may be written:



$$(b) \quad \frac{[\text{EnS}]}{[\text{En}][\text{S}]} = K_s$$



$$(d) \quad \frac{[\text{EnS}]}{[\text{En}][\text{M}]} = K_m$$

and dividing (b) by (d) gives (e)

$$(e) \quad \frac{[\text{EnS}][\text{M}]}{[\text{EnM}][\text{S}]} = \frac{K_m}{K_s} = K$$

where En = enzyme; S = succinate; M = malonate.

If we represent as 1.0 the maximum velocity of the oxidation with a given enzyme preparation, and the residual velocity at any given ratio of succinate and malonate as n , then the inhibited respiration is $1-n$. Under these conditions,

$$(17) \quad n \propto [\text{EnS}] \quad \text{and} \quad 1-n \propto [\text{EnM}]$$

and

$$(18) \quad \frac{n}{1-n} \cdot \left[\frac{\text{M}}{\text{S}} \right] = K$$

We have calculated K from the data of Potter and Dubois, and in eight out of nine experiments it lay between 0.017 and 0.024, with an average value of 0.0196. In other words, when the ratio

of malonate to succinate is 0.02, the activity of the enzyme is inhibited 50 per cent.

Potter and DuBois have postulated that the succinate combines with an $-\text{SH}$ group of the enzyme and with two peptide bonds, as is dia-

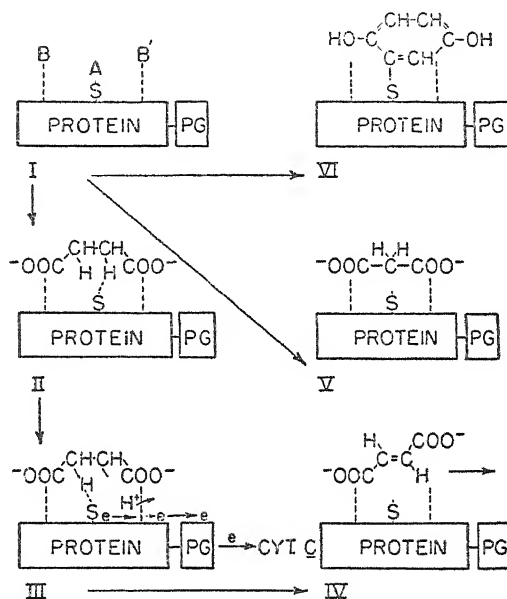


FIG. 1. SCHEMATIC REPRESENTATION OF THE STRUCTURE OF SUCCINIC DEHYDROGENASE ON THE BASIS OF MUTUALLY EXCLUSIVE INHIBITOR REACTIONS

The protein is succinic dehydrogenase, and PG represents its hypothetical prosthetic group.

I = enzyme showing the succinic acid activating center. A is a sulfhydryl amino acid, e.g., cysteine, in a peptide chain; B and B' are carbonyl affinity points, e.g., $-\text{NH}-$ groups of adjacent peptide linkages, capable of forming hydrogen bonds with the carbonyl oxygens.

II = enzyme-succinic acid complex in first stage of succinic acid oxidation.

III = enzyme-succinic acid complex in a possible intermediate stage of succinic acid oxidation.

IV = enzyme-fumaric acid complex resulting from the oxidation of succinic acid.

V = enzyme-malonic acid complex. Only the carbonyl affinity points are involved. Inhibition is reversible. Enzyme-sulfhydryl shielded by malonate and thereby protected against sulfhydryl reagents.

VI = enzyme-quinone complex, as an example of inhibition by a sulfhydryl reagent (quinone). Analogous complexes formed with other quinonoid compounds, thiol reagents, thiols, heavy metals, arsenite, and selenite.

(Potter and Dubois, 1943.)

grammed in their figure 1, reproduced here. They have illustrated the oxidation of the substrate on the enzyme as occurring in two steps, and the intermediate stage, as shown in No. III of their figure, is an enzyme-semiquinone.

The evidence for oxidation through univalent steps has been well reviewed by Michaelis and Schubert (1938); and we shall, therefore, not repeat the evidence here. There is little direct evidence for semiquinone formation in the binary complex of substrate-enzyme or in the ternary complex, but it seems highly probable that this is the case. Univalent oxidation is essential in the kinetic treatment to avoid the necessity of more than bimolecular reactions; the kinetic evidence clearly shows that no justification exists for assuming reactions of higher order. Further discussion of this problem occurs in Section III.

One of the most interesting aspects of enzymes is their specificity. The enzymes of oxidation-reduction are usually specific as to both electron acceptor and donor, though the specificity may be broader for the acceptor than for the donor, or the reverse. Of the many possible oxidations in a cell, only certain specific ones occur at a measurable rate. This specificity virtually eliminates from serious consideration the chain reactions, such as those proposed by Haber and Willstätter (1931), Weiss (1946a, b), and Moelwyn-Hughes (1937), as well as concepts of oxygen activation.

Pauling (1946) has proposed the following explanation for enzyme specificity: "From the standpoint of molecular structure and the quantum-mechanical theory of chemical reaction, the only reasonable picture of the catalytic activity of an enzyme is that which involves an active region of the surface of the enzyme which is closely complementary in structure not to the substrate molecule itself, in its normal configuration, but rather to the substrate molecule in a strained configuration, corresponding to the 'activated complex' for the reaction catalyzed by the enzyme; the substrate molecule is attracted to the enzyme, and caused by the forces of attraction to assume the strained state which favors the chemical reaction—that is, the activation energy of the reaction is decreased by the enzyme to such an extent as to cause the reaction to proceed at an appreciably greater rate than it would in the absence of the enzyme. . . . If the enzyme were completely complementary in structure to the substrate, then no other molecule would be expected to compete successfully with the substrate combining with the enzyme, which in this respect would be similar in behavior to antibodies; but an enzyme complementary to a strained substrate molecule would attract more strongly to itself a molecule resem-

bling the strained substrate molecule than it would the substrate molecule." In the same articles Pauling cites some examples.

Beadle (1945) has shown that in the absence of genes in certain cases no enzymatic reaction occurs. Emerson (1945) has suggested that the genes form the enzyme molecules by using their own surfaces as templates for the enzyme molecule, thus creating active centers on the enzyme surface. This implies that the active sites on enzymes are sensitive to the interatomic spacing within the enzyme molecule, just as active sites on surface catalysts are sensitive to interatomic spacing. The concept that the interatomic spacing determines the activity of the catalyst was suggested by Langmuir (1921), given a quantum-mechanical explanation by Sherman and Eyring (1932), and verified experimentally by Beeck, Smith, and Wheeler (1940). This does not imply that the enzyme molecule absorbs molecules over its entire surface. It only implies that on the enzyme surface there exist specific sites at which "activated complexes" between enzyme and substrate may form. Oxidation-reduction enzymes are so shaped that chemical bonds are formed which facilitate the exchange of electrons.

II. ACTIVATION ENERGY AND COLLISION NUMBERS

A. Symbols

κ	= Boltzmann's constant
h	= Planck's constant
T	= Absolute temperature
R	= Gas constant = 8.315×10^7 ergs deg. ⁻¹ , 1.98 cal. deg. ⁻¹
e	= Base of natural logarithms
ΔF^*	= Free energy of activation for formation of the "activated complex"
ΔH^*	= Total energy of activation for formation of the "activated complex"
ΔS^*	= Entropy of activation for formation of the "activated complex"
E_e	= Experimental energy of activation in solu- tion in kcal. mole ⁻¹
Z	= Collision frequency per enzyme molecule
Z_e	= Collision frequency of enzyme and sub- strate molecules
A	= Activated collision frequency per enzyme molecule
σ_{ee}	= $\frac{\sigma_e + \sigma_s}{2}$
σ_s	= Diameter of enzyme molecule in ång- ströms

- σ_s = Diameter of substrate molecule in ångströms
 n_e = Concentration of enzyme in molecules per milliliter
 n_s = Concentration of substrate in molecules per milliliter
 M_e = Molecular weight of the enzyme molecule
 M_s = Molecular weight of the substrate molecule

B. Activation Energy

Biological processes must be completed in a finite amount of time. In general, it appears reasonable to state that processes on the main pathway of energetic metabolism should proceed to half-completion in a fraction of a second, though enzymatic processes of digestion, syntheses of storage products, and some processes involved in growth and differentiation, may have half-lives of hours or even days. The rate constant of the reaction and, therefore its half-life, is determined by the free energy of activation. The upper limit placed upon the free energy of activation in enzymatic reactions may be calculated from the "transition-state" theory (Glasstone, Laidler, and Eyring, 1941). In this theory, the rate constant for any reaction is given by:

$$k = \frac{\kappa T}{h} e^{-\Delta F^*/RT} = \frac{\kappa T}{h} e^{-\Delta H^*/RT} e^{\Delta S^*/R} \quad (1)$$

In terms of the experimental activation energy of a reaction taking place in homogeneous solution, equation (1) becomes

$$k = \frac{e\kappa T}{h} e^{-E_e/RT} e^{\Delta S^*/R} \quad (2)$$

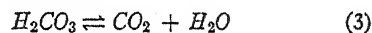
In Fig. 2, values of $\log k$ calculated by equation (1) are plotted against ΔF^* . Corresponding values of the half-life for a monomolecular reaction of rate constant, k , are given on the right-hand ordinate. If it is assumed that the entropy of activation is zero, values of k can also be calculated from the experimental values of the activation energy; in such cases, $\Delta F^* = E_e - RT$. Values of E_e are given on the upper abscissa; the experimental activation energies for several enzymatic reactions are also indicated (Sizer, 1943). As virtually all bimolecular reactions are much slower than monomolecular reactions, it appears reasonable to limit the free energy of activation for enzymatic reactions to values of less than twenty-five

kcal. mole⁻¹. The heavy lines of Fig. 2 mark the area of biological interest.

It is probable that enzymic reactions with experimental energies of activation of the order of 5 kcal. mole⁻¹ or less are diffusion-limited reactions, i.e., every collision of a substrate molecule with an active center of the enzyme leads to reaction. It may be that some of the enzyme molecules are so shaped that colliding molecules tend to move toward the active centers, so that virtually every collision will lead to reaction. Debye (1942) has stated that activation energies of 4 to 5 kcal. mole⁻¹ or less may easily be explained by diffusion processes.

It would be interesting to compare the activation energies of uncatalyzed reactions with the activation energies of enzyme-catalyzed reactions. The activation energy of the uncatalyzed reaction is usually so high that the reaction does not proceed with a measurable velocity at neutral pH and at physiological temperatures. At high temperatures, the reactants are often unstable, or the products of the reaction markedly different.

Two of the simplest chemical reactions known for which enzymes have been isolated are the dehydration of carbonic acid and the reduction of hydrogen peroxide. For example, the E_e of the uncatalyzed reaction



is 20.45 kcal. mole⁻¹. The E_e of the reaction catalyzed by carbonic anhydrase is given as from 8.7 to 11.7 kcal. mole⁻¹ (Brinkman, Margaria, and Roughton, 1933). Assuming that the higher value is correct, and ignoring any entropy factors that may be involved, this results in an increase in rate of a millionfold, as is shown in Fig. 2. The E_e for the uncatalyzed decomposition of H_2O_2 is 18.0 kcal. mole⁻¹, while for the enzymic decomposition by catalase it is 6.4 kcal. mole⁻¹ (Moelwyn-Hughes, 1933a), and for decomposition in the presence of colloidal platinum, it is 11.7 kcal. mole⁻¹. Again ignoring entropy factors, such a decrease in activation energy means that the enzymic reaction is 10⁸ times faster than the uncatalyzed reaction, and that catalase is more than 5600 times as efficient a catalyst as platinum black. The rates are calculated from Fig. 2.

C. Collision Numbers

In equation (2), the factor $e^{\left(\frac{\kappa T}{h}\right) e^{\Delta S^*/R}}$ corre-

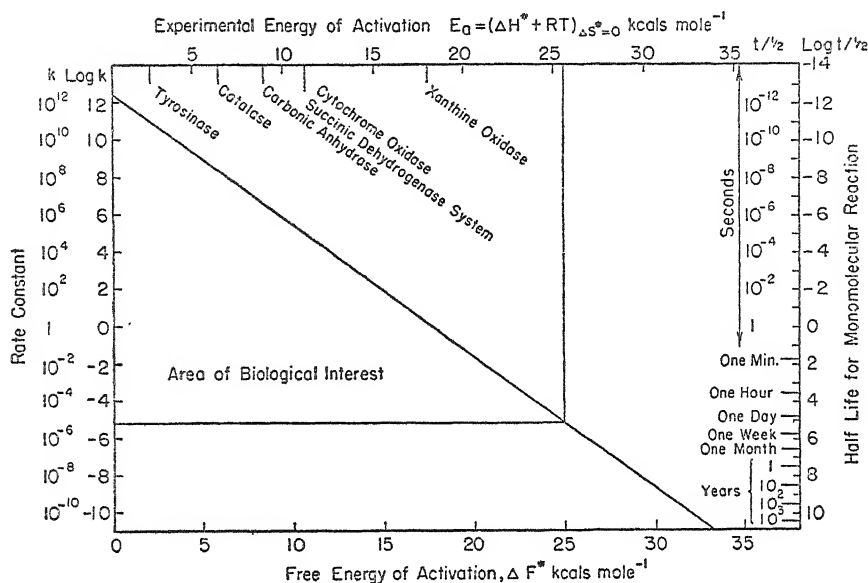


FIG. 2. CHANGE IN RATE CONSTANT WITH CHANGE IN THE FREE ENERGY OF ACTIVATION

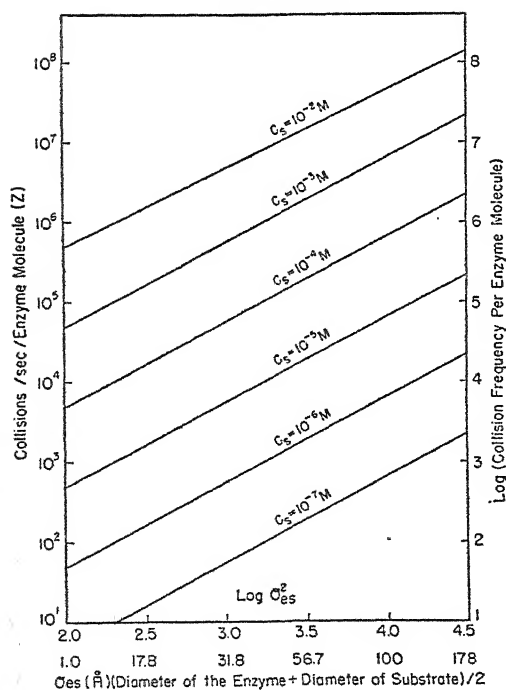


FIG. 3. CHANGE IN COLLISION FREQUENCY PER ENZYME MOLECULE WITH CHANGE IN THE DIAMETER OF THE LATTER FOR GIVEN SUBSTRATE CONCENTRATIONS

sponds to the PZ factor of the collision theory of reaction rates (Moelwyn-Hughes, 1933a). As our knowledge of the entropy change, ΔS^* , is

rather meager, we shall use the kinetic collision theory in the following discussion of collision frequency. We are interested in the frequency with which one enzyme molecule undergoes collision with the substrate molecules and in the factors that affect this collision frequency. The collision frequency per enzyme molecule is given by:

$$Z = \frac{eZs}{n_s} = \sigma_{es}^2 n_s \sqrt{8\pi RT \left[\frac{1}{M_s} + \frac{1}{M_e} \right]} \quad (4)$$

The collision equation has been derived for collisions in gases. Although there is some question as to the applicability of this equation to solutions (Debye, 1942; Moelwyn-Hughes, 1933a), we shall use it here on the assumption that it yields correct values. Assuming that the molecular weight of the substrate is in the neighborhood of 100 and that the molecular weight of the enzyme lies between 10^4 and 10^6 , values of $\log Z$ are plotted against $\log \sigma_{es}^2$ for several values of the substrate concentration in Fig. 3. The collision frequency per enzyme molecule increases linearly with σ_{es}^2 and with the concentration of the substrate.

In Fig. 4, the logarithm of the Boltzmann factor, $e^{-E_c/RT}$, is plotted against E_c . This gives the fraction of the molecules with activation energy, E_c , for a given value of E_c . If an activated collision is defined as a collision in which there is sufficient activation energy for the reaction to take place, the equation,

$$A = Ze^{-E_c/RT} \quad (5)$$

gives the activated collision frequency per enzyme molecule, A . In Fig. 5, the activated collision frequency per enzyme molecule is plotted against the activation energy for several values of the collision frequency. From Fig. 5, it is easily seen that an activation energy of 5.1 kcal. mole⁻¹ means that only 1 in 10⁴ collisions will have suffi-

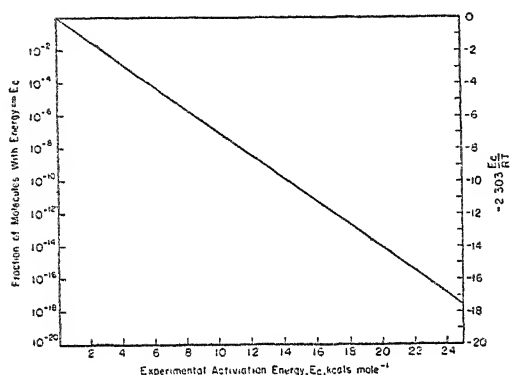


FIG. 4. FRACTION OF MOLECULES WITH ACTIVATION ENERGY, E_c

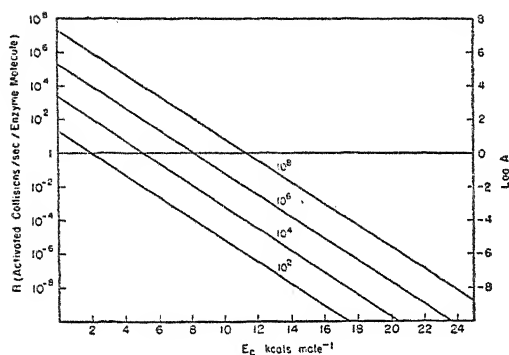


FIG. 5. CHANGE IN ACTIVATED COLLISION FREQUENCY PER ENZYME MOLECULE WITH CHANGE IN ACTIVATION ENERGY FOR GIVEN VALUES OF THE COLLISION FREQUENCY

ent energy for a reaction to result, provided all the other necessary conditions are fulfilled. Similarly, an activation energy of 11.3 kcal. mole⁻¹ means that only 1 in 100 million collisions may result in reaction. In Fig. 6, the activated collision frequency per enzyme molecule is plotted against $\log \sigma_{es}$ for given values of the substrate concentration and of the activation energy. It is immediately observed that a substrate concentration of 10⁻⁸M and an activation energy of one kcal. mole⁻¹ gives a greater activated collision frequency

than a substrate concentration of 10⁻²M and an activation energy of 10 kcal. mole⁻¹.

All of the foregoing calculations have been made, ignoring completely the entropy of activation. If we assume that every collision with activation energy E_c and activation entropy ΔS^* leads to reaction, Fig. 7 gives the reaction frequency per enzyme molecule plotted against the entropy of activation for given values of the activated collision frequency per enzyme molecule. A small change in the entropy of activation can alter the reaction frequency per enzyme molecule (reaction rate) considerably; thus, an increase of 10 kcal. mole⁻¹ degree⁻¹ in the entropy of activation will increase the reaction rate over a hundredfold.

If we assume that ΔS^* is zero, approximate values of k can be calculated from the values of E_c given by Sizer (1943), using Fig. 2. These calculations are summarized in Table 1. Catalase has a rate constant of 2.4×10^8 liters mole⁻¹ second⁻¹. Haldane (1931) has calculated that the minimum rate constant for catalase would be 0.76×10^7 liters mole⁻¹ second⁻¹. Since the molecular weight of catalase is given by Sumner and Gralen (1938) as 248,000 and the partial specific volume as 0.73 ml. per gram, the calculated radius, assuming a spherical molecule, is 41.6 Å, giving a total collision frequency of 1.3×10^{10} per enzyme molecule per second, or an activated collision frequency of 2.9×10^5 ; whereas the rate constant demands 2.4×10^8 reactions per second. Even though catalase contains 3 hemes, it seems highly improbable that every collision will lead to reaction; therefore, either the entropy of activation is positive or the frequency of collision cannot be safely calculated by the gas equation.

III. SEMIQUINONES AND REACTION KINETICS

Michaelis and Schubert (1938) have developed the complete semiquinone theory for reactions in equilibrium, and have suggested that the semiquinone constant must not be too small if the reaction is to be reversible. Weiss (1946a, b) has stressed the role of dimerization and dismutation reactions in free radical mechanisms. Recently, LuValle and Weissberger (1948) have systematically applied the semiquinone theory of Michaelis to autoxidation kinetics in aqueous solution. They found that much of the autoxidation data could be systematized and classified upon the basis of the rate laws derived from the postulated mechanisms. All of the mechanisms are derived from

one basic group of equations by varying the relative values of the specific reaction rate constants. In the non-catalytic and autocatalytic reactions, the semiquinone is found to exist free in the solu-

are best explained by formation of complexes between inhibitor and semiquinone. Rather than derive these equations again, we refer the interested readers to the original papers.

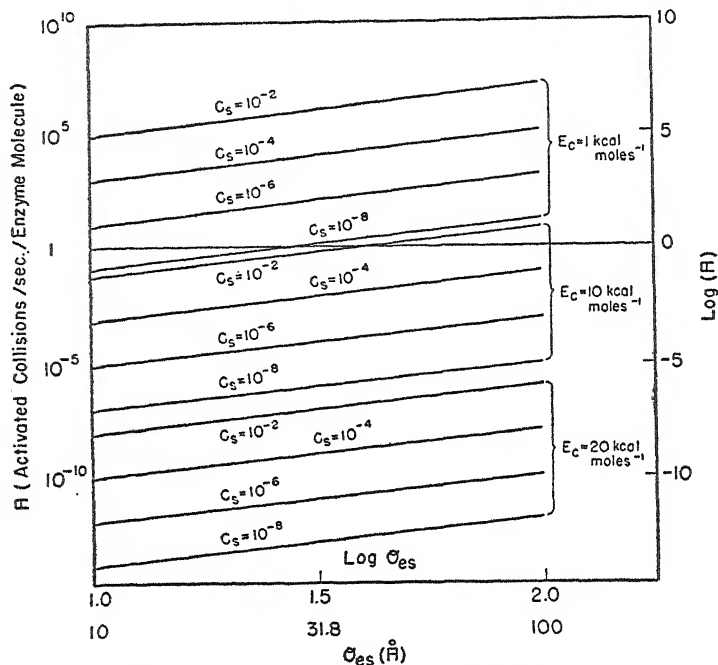


FIG. 6. CHANGE IN ACTIVATED COLLISION FREQUENCY PER ENZYME MOLECULE WITH THE DIAMETER OF THE LATTER FOR GIVEN VALUES OF SUBSTRATE CONCENTRATION AND ACTIVATION ENERGY

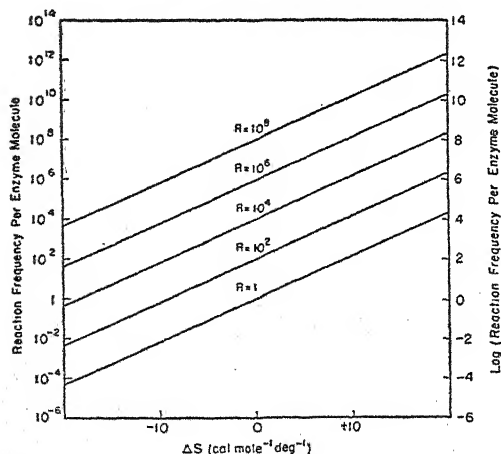


FIG. 7. EFFECT OF ENTROPY OF ACTIVATION ON THE REACTION FREQUENCY PER ENZYME MOLECULE

tion. In catalyzed reactions, the data are best explained by formation of ternary complexes between catalyst, donor substrate, and acceptor substrate, oxygen. In inhibited reactions, the data

TABLE 1
Rate Constants for Enzymatic Reactions
Calculated on the Assumption That ΔS^* Is Negligible

ENZYME	E_a kcal/mole	k^{++} second ⁻¹
Tyrosinase.....	2.7	9.7×10^{10}
Catalase.....	6.4	2.4×10^8
Carbonic anhydrase.....	8.9	4.5×10^6
Cytochrome oxidase.....	11.2	1.0×10^5
Xanthine oxidase.....	18	1.7

^{++}k is here a pseudomonomolecular rate constant.

We do not believe it probable that the formation of unbound semiquinones or free radicals plays an important role in cellular metabolism, but prefer to visualize the semiquinones as formed within the enzyme complex and remaining within the complex throughout their lifetime. By such a mechanism we retain the concept of enzyme specificity and avoid the initiation of chain reactions or non-specific oxidations. Any appreciable

formation of unbound free radicals should lead to the destruction of life itself.

Michaelis and Smythe (1938) have suggested that biological oxidation-reductions proceed through semiquinone formation. Haas, Harrer, and Hogness (1942) have found evidence for the presence of alloxazine free radicals in experimental work with cytochrome reductase. However, they were not able to demonstrate that the alloxazine semiquinone was not bound to the protein. Michaelis (1940) has stated the probable role of the semiquinone in the kinetics of oxidation-reduction as follows:

"Now we may justly assert that radicals have been shown to exist in all the more familiar classes of reversible bivalent oxidation-reduction systems. In irreversible systems, such as alcohol-aldehyde, no intermediate radical has been demonstrated to exist in equilibrium with its parent substances, at least not to an analyzable amount. We can conclude herefrom, that the semiquinone formation constant must not be too small if the system should behave as a reversible one. Any bivalent oxidation must and can proceed only in univalent steps. Provided the radical formation constant is not too small, it does not matter how large it is; it may be 1000 or 0.01; the concentration of the radical during oxidation-reduction in this case is not the limiting factor for the rate of reaction. If, however, this constant becomes too small, the concentration of the radical may become the limiting factor of the rate, and then the process will be sluggish. In this case, the energy of formation of the intermediate radical is so high that its formation represents the essential part of the activation energy of the bivalent oxidation. When, in neutral or acid solution, alcohol is to be oxidized, the potential range of the oxidizing agent must be positive enough to form the radical; and if aldehyde is to be reduced, the potential range of the reducing agent must be negative enough to form the radical. The difference of the potential range of that oxidizing agent just strong enough to oxidize alcohol at a measurable speed, and that of the reducing agent just strong enough to reduce aldehyde with a measurable speed, is the difference between what Conant and Fieser have called the apparent oxidation potential of alcohol, and the apparent reduction potential of aldehyde. In a reversible system, both coincide; in other words, there is no over-voltage either in reduction or in oxidation. The role of a catalyst, or a respiratory

enzyme, is to diminish the energy necessary to form the intermediate radical. For this purpose, the catalyst should be able to form a compound with the substrate in which the equilibrium between the oxidized form of the substrate, the reduced form, and the intermediate radical, is more in favor of the radical than in the uncombined substrate itself. Although this idea still needs further experimental support, it has in any case the advantage of reducing a problem of kinetics to one of thermodynamics."

IV. MECHANISM OF REACTIONS AND RATE LAWS

A. Symbols

E	= enzyme; includes prosthetic group other than coenzyme.
E_s, E_s^+	= enzyme semiquinones.
Co	= coenzyme.
CoH	= coenzyme semiquinone.
CoH_2	= leuco coenzyme.
RH_2	= leuco donor which may undergo a bivalent oxidation.
$RH_2^+ RH$	= semiquinone of leuco donor.
R	= oxidized donor.
RH	= donor which may undergo a univalent oxidation.
R	= oxidized donor which may undergo a univalent reduction.
A	= acceptor which may undergo a bivalent reduction.
A^-, AH	= acceptor semiquinone.
AH_2	= leuco acceptor.
O_2	= oxygen acting as an acceptor.
O_2^-	= perhydroxyl ion.
HO_2^-	= hydroperoxide ion.
HO	= hydroxyl radical.

B. General Concepts—Basic Assumptions

This section consists of a simplified treatment of the mechanisms of oxidation-reduction, and many possible mechanisms will be omitted. The mechanisms derived for the several classes of oxidation-reduction enzymes are based upon the two following basic assumptions:

- (1) *All reactions proceed through a series of univalent electron exchanges.*
- (2) *A ternary complex of donor, enzyme, and acceptor must be formed for the reaction to proceed to completion.*

Upon these two assumptions it is possible to construct a rational picture of enzymatic action in

biological oxidations which is fundamentally the same for all classes of oxidative-reductive enzymes.

If we combine the ideas of Pauling (1946) and Michaelis (1940, 1946) with the ideas we have developed, an oxidative-reductive enzyme may be pictured as a protein molecule which has several active centers on the surface. One of these sites is specific for the prosthetic group (when such a group is required). Of the remaining active sites, part are specific for the donor substrate (electron donor) and part for the acceptor substrate (electron acceptor). The specificity varies with the enzyme and is ascribed to its shape and to the interatomic distances on the surface of the sites, especially to the interatomic distances between those atoms which form chemical bonds (Pauling, 1940) with the substrate. These bonds facilitate the transfer of electrons between the donor and the acceptor. The donor and acceptor sites must be connected by a mobile electron system. In some cases the prosthetic group may serve as one of the specific sites. The number of active sites may vary upwards from two (one for each substrate).

The enzyme-substrate bond is probably a bond between two free radicals formed in a univalent oxidation-reduction when the substrate is initially attached to its site. The bond may be stabilized by resonance, or it may be a hetero-dimer bond formed by the two free radicals. Where sulfhydryl groups are present in the substrate site, the dimer bond is probably to the sulfur atom. Discussion of the exact nature of the mobile electron system connecting the active sites on the protein must await more information about the structure of the sites and the protein surface.

The prosthetic group of an enzyme may actually undergo an oxidation-reduction during the enzymatic cycle, it may serve merely as a mobile electron system which transmits electrons from one active site to another active site, or it may serve to stabilize the protein in certain intermediate states. The transition group elements, e.g., Fe, Cu, Zn, all have low-lying vacant outer orbitals which may be utilized to stabilize some of the transitory structures by formation of bonds similar to those found in ionic complexes, e.g., $\text{Fe}(\text{CN})_6^{3-}$, CuCl_2^- , and $\text{Cu}(\text{NH}_3)_4^{++}$. Calvin and Wilson (1945) have suggested a similar stabilization of chelate structures. For the dehydrogenases, however, the coenzyme can be thought of as playing the role of an electron acceptor or donor, according to the reaction in which it is involved. This electron

acceptor or donor undergoes bivalent oxidation-reductions.

Inhibition of enzymatic reactions is of considerable theoretical as well as experimental interest. Enzymatic reactions may be inhibited by any one of several means: (a) by the removal of a substrate by a competing reaction; (b) by denaturation or precipitation of the enzyme by high temperatures, ultraviolet light, and x-rays (Northrop, 1938), by denaturing and precipitating agents and the presence of high or low pH; (c) by the action of certain non-specific surface-active agents, such as the urethanes and octyl alcohol—the mode of action of these agents is not very clear, but presumably they block the active sites or change the surface configuration; (d) by agents which react with certain specific groupings, such as the reaction of enzyme sulfhydryl groups with iodoacetic acid, arsenoxides, and phenyl mercurial salts; (e) by substances of chemical configuration similar to the natural substrate, such as the malonic acid inhibition of succinic dehydrogenase (Roblin, 1946, has reviewed the literature of this type of inhibition); (f) by substances which act at the site of normal attachment of the prosthetic groups; or (g) by compounds which form active complexes with the metal atoms of the prosthetic groups, such as CO, HCN, HN_3 , NH_2OH , etc. The new complex may block out the acceptor or donor from the complex, or the inhibitor may effectively prevent electron exchange between the two substrates through the enzyme by blocking of the outer orbitals of the transition group elements and thus prevent the use of these orbitals in the stabilization of intermediate enzyme structures. Thus, the azide inhibition of catalase may be due to the prevention of the formation of the ternary complex, H_2O_2 -catalase- H_2O_2 , by the formation of the relatively stable HN_3 -catalase- H_2O_2 , or to the formation of a molecular configuration which prevents electron transfer.

Further investigation of inhibition should give information as to the structure of the enzyme. Investigation of inhibition by (a), (d), (e), (f), and (g) above should give information as to the shape, nature, and perhaps composition of the active sites.

For purposes of discussion we may assume that the basic reactions are fairly simple. The enzyme and either the donor or acceptor form a binary complex, which then reacts with the other substrate (acceptor or donor) to form a ternary com-

plex. Prior to formation of the ternary complex, the binary complex may undergo an internal univalent oxidation-reduction, forming a binary radical consisting of a complex of enzyme semiquinone and substrate semiquinone. The ternary complex undergoes a series of univalent electron exchanges, followed by dissociation into free enzyme and the products of the reaction. We shall assume that only electron exchange takes place within the complex and that the transfer of hydrogen ion takes place via the solvent through ionization processes. Actually, the hydrogen ion dissociated is probably rarely the hydrogen ion associated. A transfer of hydrogen atoms probably rarely occurs, since it cannot occur as free atomic hydrogen, which would literally burn up the cell, because it would react with its first collision partner. The probability of transferring a proton plus an electron simultaneously without release of atomic hydrogen is much less than electron transfer preceded or followed by hydrogen-ion dissociation. The ionization processes may precede complex formation, occur during the life of the complex, or follow complex dissociation. Hogness (1942) and Barron (1942) have expressed similar views regarding hydrogen transport.

In the following sections the mechanisms of reaction for the several classes of oxidative-reductive enzymes are developed in detail and the corresponding rate laws derived from the mechanisms. In the derivation of the rate laws a simplified mechanism is used, in which reactions denoting internal electron exchange and external hydrogen-ion exchange are deleted, since the rates of electron and of hydrogen-ion exchange are not rate-limiting but only introduce equilibrium constants. The effect of ionization reactions upon the concentrations of the reactive species is also not included in the derivations, since specific experimental data for each reaction should first be available, so that the step in which ionization occurs may be located. The rate-limiting reactions are those in which complexes are formed or destroyed.

When the concentration of the donor is such that the free time (time interval during which the active site is unoccupied) of the donor site or sites is long compared to the time necessary for the ternary complex to decompose, the concentration of the donor is said to be rate-limiting. Under such conditions the enzyme accumulates as the free enzyme (when the binary complex is donor-enzyme) or as the acceptor-enzyme complex

(when the binary complex is acceptor-enzyme). The concentration of the free enzyme or binary complex becomes constant and, for all practical purposes, equal to the original enzyme concentration, i.e., the rate law becomes pseudo-monomolecular with respect to the donor concentration. Similarly, when the acceptor concentration is rate-limiting, the enzyme must accumulate either as free enzyme or as the donor-enzyme complex, and the rate law becomes pseudo-monomolecular with respect to the acceptor concentration. When the enzyme concentration is rate limiting, i.e., when the free time of both donor and acceptor sites is short relative to the time necessary for the decomposition of the ternary complex, the enzyme accumulates as ternary complex, the concentration of which becomes constant and, for all practical purposes, equal to the original concentration of enzyme. In this case, the rate becomes constant and independent of both donor and acceptor concentration. In all three rate-limiting cases, the rate constant varies with change in the total enzyme concentration.

We shall restrict the term "stability of the complex" to mean stability against dissociation into the original reactants. Thus, the binary complex will be stable when its rate of formation and its rate of reaction to form the ternary complex are both at least ten times as great as the rate of dissociation of the binary complex. The sufficient condition for stability of the binary complex is that the rate of formation be at least ten times as great as its rate of dissociation. Similar conclusions hold for the ternary complex. A steady state is said to exist for a given reactant when the rate of formation is equal to its rate of utilization. This does not imply that either the rate of formation or the rate of utilization is constant as the reaction proceeds; it only implies a linear relation between the two rates. Steady-state equations are used to solve for the concentrations of all reactive intermediates in terms of the initial reactants. These values are then used to obtain the rate laws. The case in which all the reactions have rates of the same order of magnitude is not treated, since it is highly improbable. Instead, the rate laws are derived for five more probable cases in each class of enzymes. In order that the discussion of the mechanism of action of each class of oxidative-reductive enzymes may be followed uninterruptedly, the details of the mechanism, the simplified mechanism, and the special cases of

the rate law are all placed in a table at the end of the section devoted to each class.

C. Oxidases

1. Enzymes which reduce oxygen to hydrogen peroxide

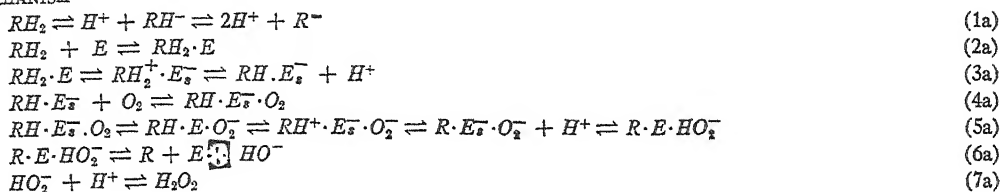
The oxidases which reduce oxygen to hydrogen peroxide, producing the latter as a primary prod-

Table 2 contains the detailed mechanism: the entire process proceeds through the univalent transfer of an electron from the donor to the enzyme forming an enzyme semiquinone; the latter then transfers its electron to the acceptor. This process is then repeated, resulting in a bivalent oxidation-reduction of the substrates.

If the enzyme has a coenzyme, the coenzyme

TABLE 2
Oxidase Reactions in Which the End Product Is H_2O_2

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAW

- a. The complexes are very stable and do not tend to dissociate into their original components, i.e., k_{-1} and k_{-2} are negligible:

$$\frac{-d[RH_2]}{dt} = k_1[E][RH_2] \quad (A-1)$$

- b. Donor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_1[E][RH_2] = k'_1[RH_2] \quad (A-2)$$

- c. Acceptor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_2[E \cdot RH_2][O_2] = k'_2[O_2] \quad (A-3)$$

- d. Enzyme concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_3[O_2 \cdot E \cdot RH_2] = k'_3 \quad (A-4)$$

- e. The binary complex equilibrium controls the rate of the reaction and k_{-2} is negligible:

$$\frac{-d[RH_2]}{dt} = k_2K_1[E][RH_2][O_2] \quad (A-5)$$

uct, comprise the first class of oxidative enzymes. *d*-Amino-acid oxidase, xanthine oxidase, luciferase, and uricase are members of this class. Oxygen is the specific acceptor substrate in all cases, though in a few reactions some leuco dyes can replace oxygen. The specific donor substrate is given by the name of the oxidase.

may undergo a bivalent oxidation-reduction (cf. Section E), but the protein moiety of any oxidation-reduction enzyme is restricted to a univalent oxidation or reduction. The interatomic spacing of the site is critical. Formation of a semiquinone will not alter the spacing to any extent, for the electron is transferred across the protein to the

prosthetic group or to the other site in a time of the order of 10^{-8} second. If a bivalent oxidation-reduction occurs on the active site, at least one of the sensitive interatomic distances will be altered, which would probably lead to inactivation of the enzyme.

In all oxidase reactions, we assume that the donor-enzyme complex forms the binary radical prior to reaction with oxygen (equation 3a), the free electron of the enzyme semiquinone being near or on the surface of the acceptor site. The reaction between oxygen and a free radical does not require a large activation energy—in all probability the first oxygen that strikes the active site will undergo reaction. This assumption does not require that the oxygen undergo a mysterious "activation" prior to reaction, and it does not demand a chain reaction or free semiquinone loose in the environment. The semiquinones (free radicals) are always combined with the enzyme, and their life is very short. The stability of the enzyme-donor binary radical complex is easily explained by resonance effects. Actually there is no reason why the oxygen molecule may not form a binary complex with the enzyme, provided no electron exchange takes place until the ternary complex is formed. The perhydroxyl ion, a co-partner in the ternary complex (cf. equation 5a), only exists for a period long enough for the first electron to be transferred to the acceptor, i.e., the order of 10^{-8} second. Hence, it does not have time to attack the enzyme before losing another electron. If the hydroperoxide ion remains attached to the enzyme very long (equations 5a, 6a), the enzyme is very likely to undergo an oxidation or reduction, thus inactivating the protein moiety.

In the detailed mechanism, the hydrogen-ion transfers shown are written in the order given, for convenience, but we do not mean to imply that they must occur at the particular stages of the reaction indicated.

When the donor or acceptor concentration is rate-limiting, the rate becomes pseudo-monomolecular with respect to the donor or acceptor, respectively (equation A-2 and equation A-3). When the enzyme concentration is rate-limiting, the rate becomes constant (equation A-4). When the equilibrium for binary complex formation is established so rapidly that it controls the concentration of the binary complex, and k_{-2} is negligible,

the rate law for the reaction becomes that given by equation (A-5).

The mechanism given by Johnson, Eyring, Steblay, Chaplin, Huber and Gherardi (1945) for the luciferase-luciferin reactions, although not given in as much detail as these reactions, is very similar to the mechanism just mentioned. It is complicated by the light-emission reactions which also occur in that particular system.

2. Enzymes which reduce oxygen to water

The oxidases which reduce oxygen to water, producing the latter as a primary product, comprise the second class of oxidative enzymes. Laccase, tyrosinase, and *l*-ascorbic acid oxidase are members of this class. Oxygen is again the specific acceptor substrate for each enzyme.

The detailed mechanism is given in Table 3. The first five reactions are identical with those of the oxidases which reduce oxygen to hydrogen peroxide. The dissociation of the ternary complex following the bivalent oxidation-reduction, however, now gives oxidized donor and the binary complex ($\text{HO}_2 \cdot \text{E}$) (equation 1b) in place of oxidized donor, free enzyme, and hydrogen peroxide. The binary complex ($\text{HO}_2 \cdot \text{E}$) then combines with another donor molecule to form a ternary complex, which then undergoes a second series of univalent changes (equation 3b, 4b), producing a second oxidized donor molecule, the original enzyme, and two molecules of water (equation 4b, 5b). The binary complex ($\text{HO}_2 \cdot \text{E}$) may, however, undergo an irreversible reaction which causes inactivation of the enzyme (equation 2b). The inactivation may take any of several routes: (1) internal oxidation-reduction of the hydroperoxide followed by dehydration, which will produce a ketonic linkage at the point of attachment to the enzyme; (2) internal oxidation-reduction of the hydroperoxide followed by loss of atomic oxygen, which will produce an alcoholic group at the point of attachment, and the atomic oxygen will probably oxidize some adjacent portion of the enzyme; (3) occurrence of a second oxidation resulting in the scission of the enzyme; or (4) formation of a radical which will form polymeric peroxide with another enzyme or initiate a chain polymerization of the enzyme. These four reaction paths leading to inactivation of the enzyme are those known to occur after formation of hydroperoxide in the chain autoxidation of hydrocarbons (Bolland and Gee, 1946; Gee, 1946; Farmer, 1946; Zuidema, 1946). If the ($\text{HO}_2 \cdot \text{E}$)

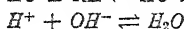
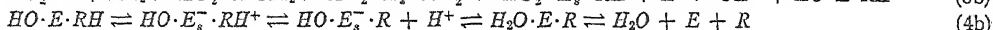
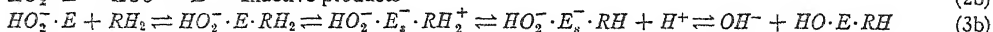
complex does not combine with a donor molecule in a short interval of time, inactivation results.

This mechanism explains the pronounced inactivation of the enzymes of this class when they are not protected by catalase-active or peroxidase-

tion lies at pH 5.6. At this pH the monovalent ascorbate ion constitutes 97 per cent of the total ascorbic acid. As the cupric-ion catalysis of the autoxidation of *l*-ascorbic acid has been shown to proceed through the monovalent ascorbate ion

TABLE 3
Oxidase Reactions in Which the End Product Is H₂O

MECHANISM: Reactions (1a) through (5a) from Table 2 followed by:



SIMPLIFIED MECHANISM: Reactions (1) and (2) followed by:



SPECIAL CASES OF THE RATE LAW

a. k_{-1} , k_{-5} , k_{-2} negligible, i.e., the complexes do not tend to dissociate into their original components to any extent:

$$\frac{-d[RH_2]}{dt} = k_1[E][RH_2] + \frac{k_1k_5[E][RH_2]^2}{k_7+k_6[RH_2]} \quad (B-1)$$

b. Donor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_1[E][RH_2] + k_5[HO_2^- \cdot E][RH_2] = [k_1' + k_5'] [RH_2] = \text{const. } \alpha [RH_2] \quad (B-2)$$

c. Acceptor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_2[E \cdot RH_2][O_2] = k_2'[O_2] \quad (B-3)$$

d. Enzyme concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_4[O_2 \cdot E \cdot RH_2] + k_6[HO_2^- \cdot E \cdot RH_2] = k_4' + k_6' = \text{constant} \quad (B-4)$$

e. The binary complex equilibrium controls the rate of the reaction, and k_{-2} and k_{-5} are negligible:

$$\frac{-d[RH_2]}{dt} = k_2K_1[E][RH_2][O_2] + k_1[E][RH_2] \quad (B-5)$$

When reaction (7) is negligible, equation (B-1) becomes:

$$\frac{-d[RH_2]}{dt} = 2k_1[E][RH_2] \quad (B-1a)$$

active enzymes. *l*-Ascorbic acid oxidase is an excellent example for discussion. This oxidase catalyzes the oxidation of *l*-ascorbic acid by oxygen, with reduction of the oxygen to water (Hand and Greisen, 1942; Powers and Dawson, 1944; Powers, Lewis, and Dawson, 1944; Steinman and Dawson, 1942). The optimum pH for this reac-

(Weissberger and LuValle, 1944), it is reasonable to assume that the oxidase catalysis also involves the monovalent ascorbic ion. The rate data for the cupric-ion catalysis is best explained by formation of a complex between the cupric ion, oxygen, and the monovalent ascorbate ion; however, the end product of the cupric-ion catalysis is hydrogen

peroxide. Therefore, the cupric-ion catalysis and the oxidase catalysis apparently differ in some respects. The evidence is rather strong against the intermediate formation of free hydrogen peroxide in the oxidase catalysis. Powers and Dawson (1944) found that catalase- or peroxidase-active enzymes protect ascorbic acid oxidase from inactivation, this protective power increasing with the concentration of enzyme. But the protective enzymes do not change the initial rate of oxygen uptake, and the end product remains water (Powers and Dawson, 1944). Furthermore, the peroxidase, even in ten times the concentration needed to show marked protective action, did not decompose H_2O_2 alone or at any significant rate in the presence of ascorbic acid. These data show that the protective enzymes do not destroy the hydrogen peroxide or the hydroperoxide, with formation of oxygen and water, although if the enzymatic activity of the protective enzymes is destroyed, the protective activity is also destroyed. Powers and Dawson also failed to find any evidence of a coupled oxidation of alcohol, such as that found by Keilin and Hartree (1936, 1945b). When catalase-active enzymes are added to the oxidases of the preceding section, however, the hydrogen peroxide is destroyed, with formation of water and oxygen. A discussion of the mode of protective action under these conditions is given later, following the discussion of the reaction mechanisms of peroxidase and catalase.

When the irreversible destruction of the enzyme is prevented, i.e., when equation (7) is negligible, the rate when the binary complex or all complexes are stable (equation B-1) reduces to a rate law identical in rate dependence with the rate laws of the previous section. The rate laws for the cases in which the concentrations of several reactants are rate-limiting hold only when equation (7) is negligible, for otherwise the concentration of the enzyme would be constantly decreasing. When the donor concentration is rate-limiting, the enzyme collects either as free enzyme and/or as the binary complex ($\text{HO}_2^- \cdot \text{E}$), and the concentration of both becomes constant; hence, the steady-state law is pseudo-monomolecular with respect to the donor concentration. The other cases are self-evident.

It might be argued that the oxidase adds two donor molecules prior to reaction with oxygen. If this constitutes the mechanism, it can easily be shown that the rate laws will be second-order

with respect to the donor substrate. Lineweaver and Burke (1934) give graphical methods for determining the rate dependency in enzymatic reactions. We suspect that the majority of oxidase reactions proceed in the stepwise mechanisms outlined in these tables.

3. Enzymes which reduce oxygen to water but where donor substrate may undergo only a univalent change

This comprises a special case of B in which the donor may undergo only a univalent oxidation. Cytochrome C oxidase belongs in this class. Oxygen is the specific acceptor substrate and cytochrome C is the donor substrate.

The mechanism is outlined in Table 4. It is immediately apparent that the complexes, perhydroxyl-enzyme, $\text{O}_2^- \cdot \text{E}$, (eq. 3c), hydroperoxide-enzyme, $\text{HO}_2^- \cdot \text{E}$, (eq. 5c), and hydroxyl-enzyme, $\text{HO} \cdot \text{E}$, (eq. 7c), will tend to undergo spontaneous reactions leading to inactivation of the enzyme unless their free time before reacting with a donor molecule is very short. Cytochrome oxidase is known to be stable in mildly alkaline solutions in the absence of cytochrome C (Haas, 1943); this is to be expected if the oxygen reacts with the oxidase only after the formation of the oxidase-cytochrome binary complex. We should expect the oxidase to be more stable in the presence of excess cytochrome C, which is the condition necessary to keep the free time of the radical enzymes complexes very short. Unfortunately, we can find no direct evidence on this point. The rate laws for this mechanism are first-order with respect to donor and with respect to enzyme (eqs. C-1, C-2). This dependence coincides with the experimentally determined rate dependence. Therefore, the mechanism in which four donor molecules are attached to the enzyme prior to reaction with oxygen need not be considered, for the rate laws derived from this mechanism are fourth-order with respect to the donor molecules. The rate dependence with respect to oxygen has never been investigated completely. The other rate laws (eq. C-1 to C-5 inclusive) are self-evident. In the concentration-limiting cases, the enzyme distributes itself among all the complexes which react with the rate-limiting reactant (eqs. C-2 and C-4).

D. Peroxidases and Catalases

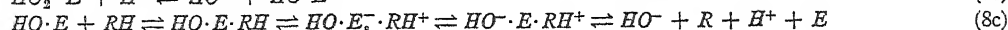
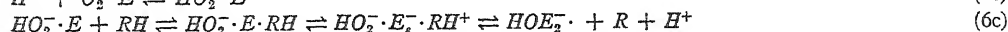
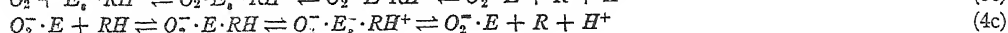
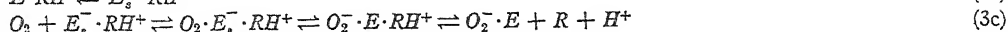
1. Peroxidases

Peroxidases and peroxidase-active enzymes are included in this class. Hydrogen peroxide acts as

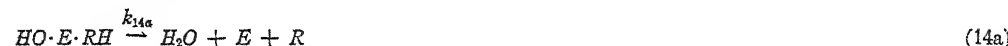
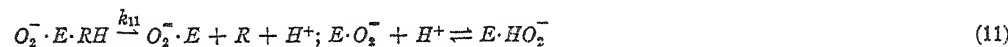
TABLE 4

Oxidase Reactions in Which Water Is the End Product, but where the Donor Can Undergo Only a Univalent Oxidation or Reduction

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAW

- a. The complexes do not tend to dissociate into their original components, i.e., k_{-7} , k_{-8} , etc., are negligible:

$$\frac{-d[RH]}{dt} = 4k_7[E][RH] \quad (C-1)$$

- b. Donor concentration is rate-limiting:

$$\begin{aligned} \frac{-d[RH]}{dt} &= k_7[E][RH] + k_{10}[O_2^- \cdot E][RH] + k_{12}[HO_2^- \cdot E][RH] + k_{14}[HO \cdot E][RH] \\ &= [k_7' + k_{10}' + k_{12}' + k_{14}'] [RH] = \text{const. } x [RH] \end{aligned} \quad (C-2)$$

- c. Acceptor concentration is rate-limiting:

$$\frac{-d[RH]}{dt} = k_8[E \cdot RH][O_2] = k_8'[O_2] \quad (C-3)$$

- d. Enzyme concentration is rate-limiting:

$$\begin{aligned} \frac{-d[RH]}{dt} &= k_9[O_2 \cdot E \cdot RH] + k_{11}[O_2^- \cdot E \cdot RH] + k_{13}[HO_2^- \cdot E \cdot RH] + k_{14a}[HO \cdot E \cdot RH] \\ &= [k_9' + k_{11}' + k_{13}' + k_{14a}'] = [\text{const.}] \end{aligned} \quad (C-4)$$

- e. The binary complex equilibrium controls the rate of the reaction, and k_{-8} is negligible:

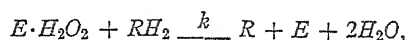
$$\frac{-d[RH]}{dt} = 4k_8K_7[E][RH][O_2] \quad (C-5)$$

If any of the partially reduced enzyme-oxygen complexes undergo irreversible decomposition, these equations (C-1 through C-5) have to be modified as in the preceding section (2).

the acceptor and many substances, e.g., *l*-ascorbic acid, leuco-malachite green, etc., may act as the donor. The enzyme is specific toward hydrogen peroxide and rather unspecific toward its donor, at least in vitro.

The mechanism, as outlined in Table 5, differs from the mechanism of Section C-1 in that the acceptor-enzyme complex is formed first. The unspecificity toward the donor may be attributed

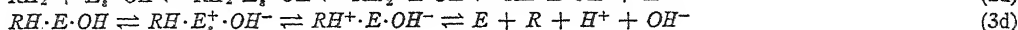
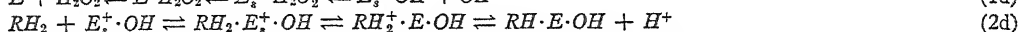
plex is very stable. The rate of decomposition of the ternary complex is so rapid that only the overall rate constant, k , of the reaction,



has been evaluated. Hence, k includes k_{16} , k_{-16} and k_{17} . The value of k , when leuco-malachite green or *l*-ascorbic acid is used as acceptor, is of the order of 10^5 liters mole⁻¹ second⁻¹ (Chance, 1943a).

TABLE 5
Peroxidase and Peroxidase-Active Enzymes

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAW

- a. k_{-15} and k_{-16} are negligible; i.e., complexes do not dissociate into original components to any extent:

$$\frac{-d[RH_2]}{dt} = k_{15}[E][H_2O_2] \quad (D-1)$$

- b. Donor concentration $[RH_2]$ is rate-limiting:

$$\frac{-d[RH_2]}{dt} = K_{16}[E \cdot H_2O_2][RH_2] = k_{16}[RH_2] = \text{const.} \propto [RH_2] \quad (D-2)$$

- c. Acceptor concentration, $[H_2O_2]$, is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_{15}[E][H_2O_2] = k'_{15}[H_2O_2] = \text{const.} \propto [H_2O_2] \quad (D-3)$$

- d. Enzyme concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_{17}[RH_2 \cdot E \cdot H_2O_2] = k'_{17} = \text{constant} \quad (D-4)$$

- e. The binary complex equilibrium controls the rate of the reaction, and k_{-16} is negligible:

$$\frac{-d[RH_2]}{dt} = k_{16}K_{15}[E][RH_2][H_2O_2] \quad (D-5)$$

to the formation of the binary radical, $E_s^+ \cdot OH$; hence, any donor which can attach itself to the donor site will undergo reaction if the redox potentials in the ternary complex are of the right order of magnitude. The unspecificity is also attributed in part to the shape of the donor site or sites. The rate laws are self-explanatory.

Chance's data (1943a, b) justify the stepwise mechanism outlined and, furthermore, confirm the rate law of eq. (D-1), i.e., the binary radical com-

plex is very stable. Slater and Goddard (1948) have recently given evidence that peroxidase acts as an oxidase in the plant. Assume that in the plant the enzyme combines with a specific coenzyme to form a binary complex which then forms a binary radical, in which (a) the enzyme may exist as a semiquinone, or (b) the iron atom of the porphyrin may be reduced to the ferro form. The binary radical then combines with oxygen, and a normal oxidase action takes place, the oxygen being reduced to

water or hydrogen peroxide. Carbon monoxide may either form a ternary complex at the active site (competitive inhibition) or form a complex with the ferrous iron which is not necessarily the active site.

2. Catalases

Catalase and other catalase-active enzymes comprise this class. Hydrogen peroxide acts as both acceptor and donor, except in coupled oxidations, where a short-chain alcohol or amine acts as donor.

The mechanism in which hydrogen peroxide plays the dual role of acceptor and donor is given in Table 6. This mechanism is similar to that of Sumner (1941) but radically different from that of other proposed mechanisms. The mechanism may be considered as similar to that of peroxidase, in which H_2O_2 replaces RH_2 (Sections II and III of Table 6), or the mechanism may proceed via the opposite preliminary step (Sections I and III of Table 6), or electron exchange may not take place until two H_2O_2 molecules are attached to the enzyme. If the binary complex does form a binary radical, however, it must form it via the peroxidase mechanism, for, in the coupled oxidations, the alcohol or amine acts as donor (Keilin and Hartree, 1945b). Keilin and Hartree (1936, 1945b) observed coupled oxidation only in the presence of a large excess of catalase over that required to destroy H_2O_2 by the mechanism of Sections II and III of Table 6; furthermore, the efficiency of the coupled oxidation is greatest when the hydrogen peroxide is supplied slowly. Their observations may be explained as follows: A coupled oxidation can take place only when the ratio of the catalase to the hydrogen peroxide concentration is so great that the probability of two hydrogen peroxide molecules being attached to one catalase molecule is very small. Under such conditions, the binary radical, $(\text{E}_s^+ \cdot \text{OH})$, will react with the first molecule small enough to attach its oxidizable center to the vacant donor site of the catalase molecule. The unspecificity of the coupled oxidation lends added weight to this explanation.

The rate laws are self-explanatory. The experimentally determined first-order dependence with respect to enzyme and hydroperoxide is that given by eq. (E-1), i.e., the dissociation of the binary complex into its original components is negligible.

Protective Action for Other Enzymes. The pro-

TECTIVE action of catalase and peroxidase for the oxidases of group C-2 has not been explained. When catalase is added to a reaction mixture of an enzyme of group C-1, it protects the enzyme by destroying the hydrogen peroxide, with formation of water and gaseous oxygen; this may be called the normal protective action of catalase. When peroxidase is added to a reaction mixture of an enzyme of group C-1, it destroys the hydrogen peroxide, simultaneously oxidizing a donor molecule, with formation of water; this may be called the normal protective action of peroxidase. Powers and Dawson (1944) have shown that neither enzyme acts in the normal manner in the protection of oxidases of group C-2; furthermore, they have demonstrated that catalase does not cause a coupled oxidation of alcohol with oxidases of group C-2. They have suggested the following explanation: "The inaction of the oxidase may be due to some precursor of hydrogen peroxide; i.e., a 'redox' form of oxygen having a transitory existence because of performing some intermediary function in the enzymatic oxidation of ascorbic acid. It would be assumed that catalase and peroxidase have the ability to destroy this precursor at a high rate as long as they are enzymatically active, and that such decomposition would not affect the oxygen uptake or oxygen totals for complete oxidation of *l*-ascorbic acid."

Reference to Table 3 shows that perhydroxyl and hydroxyl radicals occur only in ternary complexes and that their life in the ternary complex is of the order of 10^{-8} seconds; hence, the effect of catalase or peroxidase upon either of these two radicals would be negligible. It follows that the protective action must be concerned with the binary complex of hydroperoxide-enzyme. Three possible explanations of the protective action are immediately apparent: (1) The irreversible destruction of the enzyme may lead to the formation of a radical which initiates enzyme polymerization; only a few enzyme molecules would need protection, and the normal protective action of catalase or of peroxidase would have a negligible effect upon the over-all kinetics of the ascorbic acid oxidation. (2) The oxidase and the catalase or peroxidase may form a complex in which the oxidase carries on its normal functions and is stabilized against destruction by the protective enzyme. (3) The hydroperoxide may be firmly bound to the oxidase, so that the protective enzyme forms a complex with the binary complex which is stabilized against

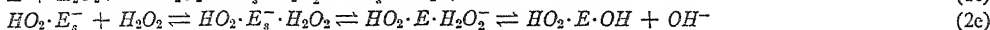
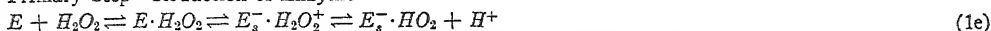
the irreversible reactions of destruction until a donor molecule is attached to the oxidase, at which point the catalase or peroxidase is released to stabilize another binary complex. Careful experimental work should enable a decision to be made on these three possibilities. This explanation

behavior of the coenzyme as either donor or acceptor, according to the reaction under investigation. In the discussion of these enzymes, the coenzyme is regarded as a substrate for the dehydrogenases, for the following reasons: (1) The dehydrogenase will not function in the absence of

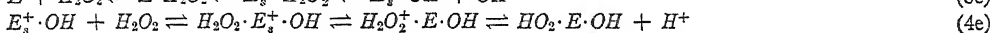
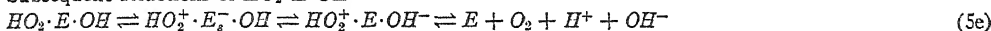
TABLE 6
Catalase and Catalase-Active Enzymes
 H_2O_2 is both donor and acceptor

MECHANISM

I Primary Step—Reduction of Enzyme



II Primary Step—Oxidation of Enzyme


 III Subsequent Reactions of $HO_2 \cdot E \cdot OH$


SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAW

a. Complexes do not dissociate into original components, i.e., k_{-18} and k_{-19} are negligible:

$$\frac{-d[H_2O_2]}{dt} = k_{18}[E][H_2O_2] \quad (E-1)$$

b. Donor concentration is rate-limiting; in this case, both donor and acceptor concentration will be rate-limiting simultaneously:

$$\begin{aligned} \frac{-d[H_2O_2]}{dt} &= k_{18}[E][H_2O_2] + k_{19}[E \cdot H_2O_2][H_2O_2] \\ &= [k'_{18} + k'_{19}][H_2O_2] = [\text{const.}][H_2O_2] \end{aligned} \quad (E-2)$$

c. Same as b

d. Enzyme concentration is rate-limiting:

$$\frac{-d[H_2O_2]}{dt} = 2k_{20}[H_2O_2 \cdot E \cdot H_2O_2] = 2k'_{20} = [\text{constant}] \quad (E-3)$$

e. The binary complex equilibrium controls the rate of the reaction, and k_{-19} is negligible:

$$\frac{-d[H_2O_2]}{dt} = k_{19}K_{18}[E][H_2O_2]^2 \quad (E-4)$$

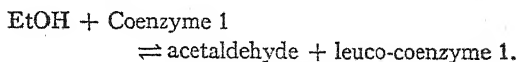
does not require the presence of any special "redox" forms of oxygen in the reaction mixture.

E. Dehydrogenases and Carriers

1. Dehydrogenases

The dehydrogenases comprise this and the next class. These two classes are characterized by the

the coenzyme. (2) The coenzyme is one of the reactants in the over-all reaction, e.g., the action of alcohol dehydrogenase of yeast:

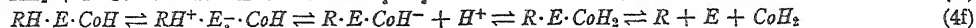
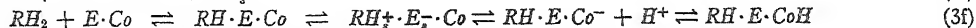


This is typical of all the dehydrogenases. The isolated coenzymes are few in number but one co-

TABLE 7
Dehydrogenases

I. Coenzyme acts as an acceptor

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAW

a. Binary complex or both complexes are stable:

$$\frac{-d[RH_2]}{dt} = k_{21}[E][Co] \quad (F-1)$$

b. Donor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_{22}[E \cdot Co][RH_2] = k'_{22}[RH_2]. \quad (F-2)$$

c. Acceptor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = k_{21}[E][Co] = k'_{21}[Co] \quad (F-3)$$

d. Enzyme concentration is rate-limiting:

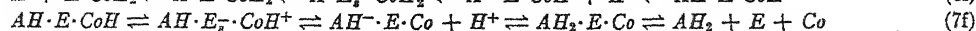
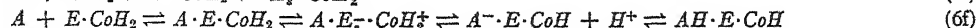
$$\frac{-d[RH_2]}{dt} = k_{23}[RH_2 \cdot E \cdot Co] = k'_{23} \quad (F-4)$$

e. The binary complex equilibrium controls the rate, and k_{-22} is negligible:

$$\frac{-d[RH_2]}{dt} = k_{23}K_{21}[E][Co][RH_2] \quad (F-5)$$

II. Coenzyme acts as a donor

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAWS

a. Binary complex or both complexes are stable:

$$\frac{-d(A)}{dt} = k_{26}[E][CoH_2] \quad (F-6)$$

TABLE 7—*Concluded*

b. Donor concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{24}[E][CoH_2] = k'_{24}[CoH_2] \quad (F-7)$$

c. Acceptor concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{25}[A][E \cdot CoH_2] = k'_{25}[A] \quad (F-8)$$

d. Enzyme concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{26}[A \cdot E \cdot CoH_2] = k'_{26} \quad (F-9)$$

e. The binary complex equilibria control the rate, and k_{-25} is negligible:

$$\frac{-d[A]}{dt} = k_{25}K_{24}[E][Co][A] \quad (F-10)$$

enzyme may function with several enzymes; e.g., "coenzyme 1 is the coenzyme for some 35 different enzymic reactions" (Sumner and Somers, 1947). This observation has led certain investigators (Warburg, 1938) to the view, that in the cell, *the coenzyme may act as a donor with one enzyme and then dissociate from the first enzyme and act as an acceptor with a second enzyme; i.e., the coenzymes act as electron-transfer agents between the dehydrogenases*. Many enzymes belong in this group, e.g., Robison ester dehydrogenase, malic acid dehydrogenase, glycerophosphate dehydrogenase, etc. Xanthine oxidase and *D*-amino-acid oxidase are also actually dehydrogenases, but as there is some question regarding the activity of the coenzyme in the oxidase reaction, we have placed these enzymes in both group C-1 and group E-1. In the discussion of group C-1, the coenzyme, together with the protein of these two oxidases, is treated as a molecular entity.

Table 7 contains the mechanism and rate laws applying to this group. In Part I, the mechanism and the rate laws are developed for the case in which the coenzyme acts as an acceptor, and in Part II, the mechanism and rate laws are developed for the case in which the coenzyme acts as a donor. The rate laws are self-evident, being identical in form with those given for the other groups of enzymes.

In these mechanisms, the formation of the binary radical complex of enzyme-coenzyme prior to formation of the ternary complex probably explains the unspecificity of some of the dehydrogenases. The rates of these reactions may be followed by the change in light absorption at 3400 Å, for the leuco-coenzyme absorbs markedly at this wave length, whereas the oxidized coenzyme does not absorb. Negelein and Wulff (1937b)

have followed the kinetics of the alcohol-acetaldehyde system at different concentrations of reactants, products, and coenzyme concentrations.

2. Flavoproteins

This class is really a special case of the preceding group and includes those dehydrogenases which reduce cytochrome, such as cytochrome reductase, succinic dehydrogenase, lactic dehydrogenase of yeast, glycerophosphate dehydrogenase No. 2, and formic dehydrogenase. Cytochrome may undergo only a univalent reduction; hence, each of these enzymes must be capable of remaining combined with the coenzyme semiquinone, CoH , in the complex, $(E \cdot CoH)$, until a second cytochrome forms a ternary complex. This implies that the coenzyme semiquinone must be stable in the complex.

Table 8 contains the mechanism and rate laws for the reaction when the coenzyme acts as donor. The mechanism and rate laws for the case in which the coenzyme acts as an acceptor are given in Part I of Table 7, for the latter action is not limited to donors which can undergo only a univalent oxidation. The rate laws are self-evident. We use the symbol RH^+ or R for the oxidized cytochrome C, and RH for the reduced cytochrome C; i.e., the same symbols as those used in Section C.

A typical example has been worked out for glucose-1- PO_3H_2 ; its dehydrogenase, coenzyme II, cytochrome reductase, and cytochrome C, by Haas, Hogness, and their collaborators (1940, 1942). They followed the activity by the rate of reduction of cytochrome C at 5500 Å, a wave length at which ferrocytochrome C absorbs more strongly than the ferri-form.

The alloxazine coenzyme group of cytochrome reductase is very strongly bound to the protein,

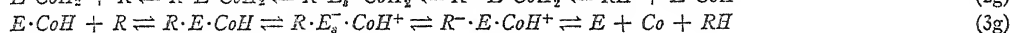
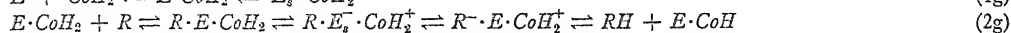
$K = 10^{-9}$, i.e., many biochemists consider it a prosthetic group rather than a coenzyme. It is rapidly reduced by coenzyme II, $k = 170 \times 10^6$ liter mole⁻¹ minute⁻¹, and is rapidly oxidized by cytochrome C, $k = 5,300 \times 10^6$ liter mole⁻¹ minute⁻¹. Although the reductase is also oxidized by oxygen, $k = 0.008 \times 10^6$, the action of cytochrome C is 10^6 times as fast, and it is therefore

formed from enzyme and acceptor. The resulting rate laws are summarized in Table 9.

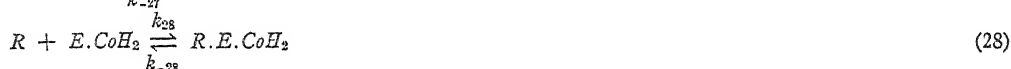
In cytochrome oxidase reactions, the radical complexes, $O_2^- \cdot E$ and $HO \cdot E$, and the hydroperoxide complex, $HO_2^- \cdot E$, have a lifetime equal to the activated collision frequency per enzyme molecule. The activation energy for reaction of these complexes with cytochrome C should be very low;

TABLE 8
Coczyme Acts as Donor

MECHANISM



SIMPLIFIED MECHANISM



SPECIAL CASES OF THE RATE LAWS

a. Binary complex or both complexes are stable:

$$\frac{-d[A]}{dt} = 2k_{27}[E][CoH_2] \quad (G-1)$$

b. Donor concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{27}[E][CoH_2] = k'_{27}[CoH_2] \quad (G-2)$$

c. Acceptor concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{28}[R][E \cdot CoH_2] + k_{30}[R][E \cdot CoH] = [k'_{28} + k'_{30}][R] = \text{constant } x [R] \quad (G-3)$$

d. Enzyme concentration is rate-limiting:

$$\frac{-d[A]}{dt} = k_{29}[R \cdot E \cdot CoH_2] + k_{31}[R \cdot E \cdot CoH] = k'_{29} + k'_{31} = \text{constant} \quad (G-4)$$

e. The binary complex equilibrium controls the rate of the reaction, and k_{-28} is negligible:

$$\frac{-d[RH_2]}{dt} = k_{28}K_{27}[E][R][CoH_2] \quad (G-5)$$

probable that oxidation by oxygen does not play a physiological role.

F. Discussion

The mechanisms and rate data for all enzymes of oxidation-reduction can be summarized under two general mechanisms: In the first mechanism, the binary complex is formed from enzyme and donor; in the second mechanism, the binary complex is

hence, their free life may be kept short if the cytochrome C is present in excess. These complexes would tend to destroy the enzyme if they remained free very long. In cytochrome reductase, the flavin coenzyme is capable of forming a stable semiquinone in the enzyme-coenzyme complex, and would therefore tend to be rather stable to reaction except with the acceptor substrate or substrates. The stability of the binary complex is

attributed primarily to the localization of the free electrons on: (a) the acceptor site or the bound acceptor substrate, and (b) the donor site or the bound donor substrate; hence, only those molecules which can enter the site will undergo reaction.

An enzyme is probably highly specific toward the substrate with which it forms the binary complex and less specific toward the substrate with which it forms the ternary complex. Once the binary radical is formed, it will react with any reactive substrate that enters the vacant site which can form chemical bonds with the active centers of the site, such that electrons can be transferred.

The enzyme sites may be visualized as shaped in such a manner that the substrates are oriented into the proper position for formation of the chemical bonds, as they approach the site. Under such conditions the redox potentials within the complex are such that univalent electron exchange occurs easily. These redox potentials are not necessarily the same as the redox potentials of the free substances. Since all electron exchanges are assumed to take place within the complex, it is not strange that reversible electrode potentials cannot be obtained without the use of mediators.

If the conditions of equation (H-1) hold, it is

TABLE 9

Summarized Rate Laws for Enzymes of Oxidation-Reduction

k_a and k_{-a} are rate constants for formation and dissociation of the binary complex.

k_b and k_{-b} are rate constants for formation and dissociation of the ternary complex.

k_c is the rate constant for formation of the products from the ternary complex.

Binary complex is $[E \cdot RH_2]$

Binary complex is $[E \cdot A]$

a. The binary complex is stable, i.e., k_{-a} is negligible:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = k_c[E][RH_2]$$

$$k_c[E][A] \quad (H-1)$$

b. The ternary complex is stable, i.e., k_{-b} is negligible:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = \frac{k_a k_b [E][RH_2][A]}{k_{-a} + k_b [A]}$$

$$\frac{k_a k_b [E][A][RH_2]}{k_{-a} + k_b [RH_2]} \quad (H-2)$$

c. Donor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = k'_a [RH_2] = k_a [E][RH_2]$$

$$k'_b [RH_2] = k_b [E \cdot A][RH_2] \quad (H-3)$$

d. Acceptor concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = k'_b [A] = k_b [E][RH_2][A]$$

$$k'_a [A] = k_a [E][A] \quad (H-4)$$

e. The binary complex equilibrium is rate-controlling, and k_{-b} is negligible:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = k_b K_a [E][RH_2][A]$$

$$k_b K_a [E][RH_2][A] \quad (H-5)$$

f. Enzyme concentration is rate-limiting:

$$\frac{-d[RH_2]}{dt} = \frac{d[A]}{dt} = k'_c = k_c [A \cdot E \cdot RH_2]$$

$$k'_c = k_c [A \cdot E \cdot RH_2] \quad (H-6)$$

The rate of reaction with the several substrates will vary, depending upon redox potentials within the complex and the ease of entering the site.

Although the coenzyme of cytochrome reductase can be oxidized by both oxygen and cytochrome C, the rate with cytochrome C is 10^6 times the rate with oxygen (Haas et al., 1942). Peroxidase is highly specific toward hydrogen peroxide but very unspecific toward its donor substrate (Chance, 1943a). Catalase will also accept donors other than hydrogen peroxide, if the concentration of the latter is so small that the probability of more than one peroxide molecule being attached to one catalase molecule is very low (Keilin and Hartree, 1936, 1945b).

easily seen that the first-order dependence upon the "binary complex" *substrate* (acceptor or donor) is due to the equilibrium being highly in favor of the complex. This also explains why the "ternary complex" *substrate* (donor or acceptor) often apparently has no effect upon the rate of the reaction.

V. EXTENDED MICHAELIS-MENTON THEORY

The development of the concepts utilized in the previous section has led to an extension of the Michaelis-Menton theory (1913). The two basic assumptions of this theory are: (1) The equation,



represents the equilibrium between enzyme and

donor, where the fraction of RH_2 combined in the enzyme is small relative to the total (RH_2). (2) The rate of the reaction is proportional to the concentration of $E \cdot RH_2$. The Michaelis constant, K_m , is given by the formula:

$$K_m = \frac{[E][RH_2]}{[E \cdot RH_2]} \quad (33)$$

Let the total enzyme present = $E_T = E + E \cdot RH_2$; then,

$$[E \cdot RH_2] = [E_T] \frac{[RH_2]}{K_m + [RH_2]} \quad (34)$$

i.e., the rate is proportional to the total enzyme concentration. When $K_m = [RH_2]$, $[E \cdot RH_2] = [E] = 1/2[E_T]$; therefore, K_m is equal to the concentration of the donor substrate which gives half maximal velocity for the given concentration of enzyme.

Michaelis and Menton did not consider the acceptor in their discussion. We shall now derive the Michaelis constants for donor and acceptor in terms of the mechanisms summarized in Table 9. (The following treatment is modeled after that used by Van Slyke, 1942, in his discussion of the original Michaelis-Menton theory.)

Let the acceptor be in large excess, i.e., a variation of the donor concentration from zero to a value sufficient to make the enzyme concentration rate-limiting will not cause the acceptor concentration to become rate-limiting. For convenience, let the binary complex be $E \cdot RH_2$; then, equation (H-3) gives the rate when the donor concentration is rate-limiting and equation (H-5) when the enzyme concentration is rate-limiting. At half maximal velocity,

$$(RH_2)_{v_{m/2}} = \frac{k_c}{k_a} \quad (35)$$

for

$$(E)_{v_{m/2}} = (A \cdot E \cdot RH_2)_{v_{m/2}} = 1/2(E_T) \quad (36)$$

and the half maximal velocity is given by

$$\begin{aligned} \left[\frac{-d(RH_2)}{dt} \right]_{v_{m/2}} &= \frac{1/2(E_T)k_c(RH_2)_{v_{m/2}}}{1 + k_a(RH_2)_{v_{m/2}}} \\ &= 1/2 \frac{k_c}{1 + k_c} (E_T) \end{aligned} \quad (37)$$

If the donor is in large excess, then equations (H-4) and (H-5) show that at half maximal velocity:

$$[A]_{v_{m/2}} = \frac{k_c}{k_b} \quad (38)$$

for $[RH_2 \cdot E] = [A \cdot E \cdot RH_2] = 1/2[E_T]$ (39) and

$$\begin{aligned} \left[\frac{-d(RH_2)}{dt} \right]_{v_{m/2}} &= 1/2[E_T] \frac{k_b[A]_{v_{m/2}}}{1 + k_b[A]_{v_{m/2}}} \\ &= 1/2 \frac{k_c}{1 + k_c} [E_T] \end{aligned} \quad (40)$$

But then the half maximal velocity in the presence of a large excess of donor is identical with the half maximal velocity in the presence of a large excess of acceptor. This result is independent of the nature of the binary complex, i.e., $[E \cdot RH_2]$ or $[A \cdot E]$. Now

$$K_a = \frac{1}{K'_a} = \frac{[E \cdot RH_2]}{[E][RH_2]} = \frac{1}{[RH_2]_{v_{m/2}}} \quad (41)$$

and

$$K_b = \frac{1}{K'_b} = \frac{[A \cdot E \cdot RH_2]}{[A][E \cdot RH_2]} = \frac{1}{(A)_{v_{m/2}}} \quad (42)$$

Therefore, K'_a and K'_b are the Michaelis constants for the donor and the acceptor, respectively, and K_a and K_b are the corresponding affinity constants. If $A \cdot E$ were the binary complex, the constants, K'_a and K'_b , would be reversed, as would the constants, K_a and K_b . It does not follow that K_a and K_b are of the same order of magnitude. In all probability, the evaluation of the Michaelis constant for the substrate which combines with the binary complex will be very difficult, for its maximal velocity may be attained at very low concentrations. However, these two constants do offer an experimental method for the determination of the occurrence of ternary complexes in enzymatic reactions.

We might define the activity of a given enzyme preparation:

$$\text{Activity} = [RH_2]_{v_{m/2}} \frac{[A]_{v_{m/2}}}{[E_T]} \quad (43)$$

where $[RH_2]$ and $[A]$ are in moles per liter and E_T in grams dry weight of enzyme per liter. Similarly, the affinity of an enzyme for its substrates could be defined:

$$\text{Affinity} = \frac{[E_T]}{[RH_2]_{v_{m/2}}[A]_{v_{m/2}}} = \frac{1}{\text{Activity}} \quad (44)$$

These definitions of the activity and affinity include all the data necessary to define a given enzyme.

Chance (1943a, b) has shown that the Michaelis theory not only explains the data in the steady state but also explains the data in the transient

portions of the rate curves. Chance's data also clearly show that the rate is a function of enzyme, acceptor, and donor concentrations. In the region where H_2O_2 concentration is rate-limiting, the rate is pseudomonomolecular with respect to hydrogen peroxide, and in the region where the donor concentration is rate-limiting, the rate is pseudomonomolecular with respect to the donor concentration. If the hydrogen peroxide concentration or the donor concentration is increased to values such that the enzyme concentration is rate-limiting, the rate becomes constant. Unfortunately, Chance's data as published do not permit the calculation of the Michaelis constant for the donor independent of the constant for the acceptor.

VI. CONCLUSIONS

While this paper was in preparation, Michaelis (1946) and Kalckar (1946) published articles in which they also proposed ternary complex formation involving the formation of semiquinones within the complex. Neither author had, however, carried his ideas as far as we have developed ours in this paper. Admittedly much of the discussion is speculative; however, the correlations which have come out of these speculations show that a very complete investigation of ternary complex formation is needed. There are already available sufficient data to justify the presentation of this hypothesis. It has the threefold advantage of (1) reducing all enzymic oxidation-reduction processes to one basic mechanism; (2) permitting the enzyme to retain its specificity while producing semiquinones and radicals; and (3) explaining oxidase reactions without the use of oxygen activation.

The comparison of the chemical reactions of an atom or molecule in a complex with its chemical reactions in another complex for the purpose of deciding the oxidation state of the atom or molecule is apt to be highly misleading. The atom or molecule in the first complex may be in the same oxidation state as the atom or molecule in the second complex, and yet exhibit utterly different properties. For instance, there are several heme proteins, but only hemoglobin acts as an oxygen-carrier. Carbon monoxide inhibition of a heme enzyme does not necessarily imply that iron in the heme enzyme is in the same oxidation state as that in hemoglobin. Other evidence, such as magnetic susceptibility measurements and absorption spectra, is needed before a conclusion may be reached.

A great deal of experimental work is needed to verify the conclusions we have reached with respect to complex formation in enzymic reactions. Some phases of the experimental approach to the problem of enzyme mechanism follow:

a. The determination of the values of the Michaelis constants for substrate and acceptor may require carefully controlled experiments, but not apparatus of a complex nature. These experiments constitute the simplest test of the hypothesis.

b. The question of hydrogen transport may be settled by the use of deuterium or tritium in enzymic reactions. Substances used must have low exchange rates with the solvent. If there is a direct transfer, not involving ionization into the solvent, the acceptor will be much richer in the isotope than the solvent. If ionization is involved in hydrogen transport, the isotope ratio of solvent and acceptor will be equal.

c. With use of labeled coenzyme molecules, it will be possible to determine the carrier role of the coenzyme. The use of such substances will involve the problem of synthesis of the coenzyme.

d. Flow machines similar to Chance's design may be used to investigate the mechanism of complex formation. Such information will prove of great value.

e. Inhibition investigations will give us some information regarding the shape and size of the active sites.

f. Correlative studies of the kinetics and thermodynamics of reactions in the presence and absence of enzymes and in the presence of other catalysts should be made wherever feasible.

g. All the techniques now available for structure determination should be applied to enzymatic proteins.

h. The construction of a double-beam infrared flow machine should be of great value in following the changes within the complexes, provided the solvent is not too opaque.

i. Micromagnetic experiments may help identify the binary radicals.

The experiments just outlined should increase our knowledge of enzyme mechanisms to some extent. We believe that all enzymes use at least two substrates, but the mechanism, for example, for proteolytic enzymes, is not necessarily the same as the mechanism for oxidative-reductive enzymes. The mechanisms proposed here are restricted to enzymes of oxidation-reduction.

LIST OF LITERATURE

- ATKIN, L. 1944. Thesis, Columbia University.
- BARRON, E. S. G. 1941. Biological oxidations and reductions. *Ann. Rev. Biochem.*, 10: 1-30.
- . 1942. *Symposium on Respiratory Enzymes*. University of Wisconsin Press, Madison.
- , and T. P. SINGER. 1945. Studies on biological oxidations. XIX. Sulfhydryl enzymes in carbohydrate metabolism. *J. biol. Chem.*, 157: 221-240.
- BEADLE, G. W. 1945. Biochemical genetics. *Chem. Rev.*, 37: 1-96.
- BEECK, O., A. E. SMITH, and A. WHEELER. 1940. Catalytic activity, crystal structure, and adsorptive properties of evaporated metal films. *Proc. Roy. Soc. Lond.*, A, 177: 62-90.
- BOLLAND, J. L., and G. GEE. 1946. Kinetic studies in the chemistry of rubber and related materials. II. The Kinetics of oxidation of unconjugated olefins. *Trans. Faraday Soc.*, 42: 236-243.
- BORSOOK, H., and H. F. SCHOTT. 1931a. The role of the enzyme in the succinate enzyme fumarate equilibrium. *J. biol. Chem.*, 92: 535-557.
- , and —. 1931b. The free energy, heat and entropy of formation of 1-malic acid. *J. biol. Chem.*, 92: 559-567.
- BRINKMAN, R., R. MARGARIA, and F. J. ROUGHTON. 1933. The kinetics of the carbon dioxide carbonic acid reaction. *Phil. Trans. Roy. Soc. Lond.*, A, 232: 65-97.
- CHANCE, B. 1943a. The effect of cyanide on the kinetics of the enzyme substrate compound and overall reaction of peroxidase. *J. cell. comp. Physiol.*, 22: 33-41.
- . 1943b. Kinetics of the enzyme substrate compound of peroxidase. *J. biol. Chem.*, 151: 553-577.
- CALVIN, M., and K. W. WILSON. 1945. Stability of chelate compounds. *J. Amer. Chem. Soc.*, 67: 2003-2007.
- DEBYE, P. 1942. Reaction rates in ionic solutions. *Trans. electrochem. Soc.*, 82: 265-271.
- DIXON, M., and L. G. ZERFAS. 1940. The role of coenzymes in dehydrogenase systems. *Biochem. J.*, 34: 371-391.
- EMERSON, S. 1945. Genetics as a tool for studying gene structure. *Ann. Missouri Bot. Garden*, 32: 243-249.
- FARMER, E. H. 1946. Peroxidation in relation to olefinic structure. *Trans. Faraday Soc.*, 42: 288-236.
- GEE, G. 1946. Low temperature oxidation of hydrocarbons. Introductory paper. *Trans. Faraday Soc.*, 42: 197-201.
- GLASSTONE, S., K. J. LAIDLER, and H. EYRING. 1941. *Theory of Rate Processes*. McGraw-Hill, New York.
- GODDARD, D. R. 1945. The respiration of cells and tissues. In *Physical Chemistry of Cells and Tissues* (R. Hober, ed.) Blakiston, Philadelphia.
- . 1944. Cytochrome C and cytochrome oxidase from wheat germ. *Amer. J. Bot.*, 31: 270-276.
- GREEN, D. E. 1940. *Mechanism of Biological Oxidations*. University Press, Cambridge, Eng.
- , and L. H. STRICKLAND. 1934. Studies on reversible dehydrogenase systems. I. The reversibility of the hydrogen use system of *Escherichia coli*. *Biochem. J.*, 28: 898-900.
- HAAS, E. 1937. Wirkungsweise des Proteins des gelben Ferments. *Biochem. Z.*, 290: 291-292.
- . 1943. Cytochrome oxidase. *J. biol. Chem.*, 148: 481-493.
- , C. J. HARRER, and T. R. HOGNESS. 1942. Cytochrome reductase. II. Improved method of isolation; inhibition and inactivation; reaction with oxygen. *J. biol. Chem.*, 143: 341-349.
- , B. L. HORECKER, and T. R. HOGNESS. 1940. The enzymatic reduction of cytochrome C. *J. biol. Chem.*, 136: 747-774.
- HABER, F., and R. WILLSTATTER. 1931. Unpaarigkeit und enzymatischer Vorgänge. *Ber. deut. chem. Ges.*, 64B: 2844-2856.
- HALDANE, J. B. S. 1931. The molecular statistics of an enzyme action. *Proc. Roy. Soc. Lond.*, B, 108: 559-567.
- HAND, D. B., and E. C. GREISEN. 1942. Oxidation and reduction of vitamin C. *J. Amer. chem. Soc.*, 64: 358-361.
- HENRI, V. 1903. *Lois generales de l'action des diastases*. A. Hermann, Paris.
- HILL, R., and D. KEILIN. 1933. Estimation of haematin iron and the oxidation reduction equivalent of cytochrome C. *Proc. Roy. Soc. Lond.*, B, 114: 104-109.
- HOGNESS, T. R. 1942. In *Symposium on Respiratory Enzymes*, pp. 134-143. Univ. Wis. Press, Madison.
- JOHNSON, F. H., H. EYRING, R. STEBLAY, H. CHAPLIN, C. HUBER, and G. GHERARDI. 1945. The nature and control of reactions in bioluminescence, with special reference to the mechanism of reversible and irreversible inhibitions by hydrogen and hydroxyl ions, temperature, pressure, alcohol, urethan and sulfanilimide in bacteria. *J. gen. Physiol.*, 28: 463-537.
- KALCKAR, H. M. 1941. The nature of energetic coupling in biological syntheses. *Chem. Rev.*, 28: 71-178.
- . 1946. In *Currents in Biochemistry* (D. E. Green, ed.), pp. 223-240. Interscience Pub., New York.
- KEILIN, D., and E. F. HARTREE. 1936. Coupled oxidation of alcohol. *Proc. Roy. Soc. Lond.*, B, 119: 141-159.

- and —. 1938a. Cytochrome oxidase. *Proc. Roy. Soc. Lond.*, B, 125: 171-186.
- and —. 1938b. On the mechanism of the decomposition of hydrogen peroxide by catalase. *Proc. Roy. Soc. Lond.*, B, 124: 397-405.
- and —. 1939a. Cytochrome and cytochrome oxidase. *Proc. Roy. Soc. Lond.*, B, 127: 167-191.
- and —. 1939b. Mechanism of decomposition of hydrogen peroxide by catalase. *Nature Lond.*, 144: 787-788.
- and —. 1945a. Properties of acid catalase. *Biochem. J.*, 39: 148-157.
- and —. 1945b. Properties of catalase. Catalysis of coupled oxidation of alcohols. *Biochem. J.*, 39: 293-301.
- and T. MANN. 1937. On the haematin compound of peroxidase. *Proc. Roy. Soc. Lond.*, B, 122: 119-133.
- LANGMUIR, I. 1921. Chemical reactions on surfaces. *Trans. Faraday Soc.*, 17: 607-620.
- LINEWEAVER, H., and D. BURK. 1934. The determination of enzyme dissociation constants. *J. Amer. chem. Soc.*, 56: 658-666.
- LUVALLE, J. E., and A. WEISSBERGER. 1948. *J. Amer. Chem. Soc.* (in press).
- MANN, P. J. G. 1931. Kinetics of peroxidase reaction. *Biochem. J.*, 25: 918-930.
- MAPSON, L. W. 1941. The influence of halides on the oxidation of ascorbic acid. *Biochem. J.*, 35: 1332-1353.
- . 1945. Influence of halides on the oxidation of ascorbic acid. II. Action of chloride ion on the cupric cuprous system. *Biochem. J.*, 39: 228-236.
- MICHAELIS, L. 1929. Oxidation reduction system of biological significance. VI. The mechanism of the catalytic effect of iron on the oxidation of cysteine. *J. biol. Chem.*, 84: 777-787.
- . 1940. Occurrence and significance of semiquinone radicals. *Ann. N. Y. Acad. Sci.*, 40: 39-76.
- . 1946. In *Currents in Biochemistry* (D. E. Green ed.), pp. 207-227. Interscience Pub., New York.
- , and M. L. MENTON. 1913. Die Kinetik der Invertinwirkung. *Biochem. Z.*, 49: 333-364.
- , and M. P. SCHUBERT. 1938. The theory of reversible two step oxidation involving free radicals. *Chem. Rev.*, 22: 437-470.
- , and C. V. SMYTHE. 1938. Biological oxidations and reductions. *Ann. Rev. Biochem.*, 7: 1-36.
- MOELWYN-HUGHES, E. A. 1933a. *The Kinetics of Reactions in Solutions*. Clarendon Press, Oxford.
- . 1933b. The kinetics of enzyme reactions. *Ergebn. Enzymforsch.*, 2: 1-22.
- . 1937. The kinetics of enzyme reactions. *Ergebn. Enzymforsch.*, 6: 23-46.
- NEGELEIN, E., and H. J. WULFF. 1937a. Kristallisation des Proteins der Acetaldehydreduktase. *Biochem. Z.*, 289: 436-437.
- , and —. 1937b. Dissoziationskonstanten und Reaktionsfähigkeit der Acetaldehydreduktase. *Biochem. Z.*, 290: 445-446.
- NORTHROP, J. 1938. *Crystalline Enzymes*. Columbia Univ. Press, New York.
- OPPENHEIMER, C., and K. G. STERN. 1939. *Biological Oxidations*, (p. 46). Nordeman Co., New York.
- PAULING, L. 1940. *Nature of the Chemical Bond*. (p. 3). Cornell Univ. Press, Ithaca.
- . 1946. Molecular architecture and biological reactions. *Chem. Eng. News*, 24: 1375-1377.
- POTTER, V. R. 1944. Biological energy transformations and the cancer problems. *Adv. Enzymol.*, 4: 201-256.
- , and K. P. DuBois. 1943. Mechanism of hydrogen transport in animal tissues. VI. Inhibitor studies with succinic dehydrogenase. *J. gen. Physiol.*, 26: 391-404.
- POWERS, W. H., and C. R. DAWSON. 1944. The inactivation of ascorbic acid oxidase. *J. gen. Physiol.*, 27: 181-199.
- , S. LEWIS, and C. R. DAWSON. 1944. The preparation and properties of highly purified ascorbic acid oxidase. *J. gen. Physiol.*, 27: 167-180.
- QUASTEL, J. H., and M. D. WHETHAM. 1924. Equilibria existing between succinic, fumaric and malic acids in the presence of resting bacteria. *Biochem. J.*, 18: 519-534.
- ROBLIN, R. O., JR. 1946. Metabolite antagonists. *Chem. Rev.*, 38: 255-377.
- SCHUBERT, M. P. 1932. Complex types involved in the catalytic oxidation of thiol acids. *J. Amer. chem. Soc.*, 54: 4077-4085.
- SHERMAN, A., and H. EYRING. 1932. Quantum mechanics of activated adsorption. *J. Amer. chem. Soc.*, 54: 2661-2675.
- SIZER, I. W. 1943. Effect of temperature on enzyme kinetics. *Adv. Enzymol.*, 3: 35-62.
- SLATER, A. M., and GODDARD, D. R. 1948. Peroxidase as a respiratory enzyme in horseradish roots. *Amer. J. Bot.*, (in press).
- STEINMAN, H. G., and C. R. DAWSON. 1942. Mechanism of the ascorbic acid-ascorbic acid oxidase reaction. The hydrogen peroxide question. *J. Amer. chem. Soc.*, 64: 1212-1219.
- STERN, K. G. 1936. The mechanism of enzyme action. A study of the decomposition of ethyl hydrogen peroxide by catalase and of an intermediate enzyme substrate compound. *J. biol. Chem.*, 114: 473-494.
- STOTZ, E., A. M. ALTSCHUL, and T. R. HOGNESS. 1938. The cytochrome C-cytochrome oxidase complex. *J. biol. Chem.*, 124: 745-754.

- SUMNER, J. B. 1941. The chemical nature of catalase. *Adv. Enzymol.*, 1: 163-176.
- , and A. L. DOUNCE. 1937. Crystalline Catalase. *J. biol. Chem.*, 121: 417-424.
- , and —. 1939. Catalase. II. *J. biol. Chem.*, 127: 439-447.
- , —, and V. L. FRAMPTON. 1940. Catalase. III. *J. biol. Chem.*, 136: 343-356.
- , and N. GRALEN. 1938. The molecular weight of crystalline catalase. *J. biol. Chem.*, 125: 33-36.
- , and G. F. SOMERS. 1947. *Chemistry and Methods of Enzymes*. Academic Press, New York.
- THEORELL, H. 1942a. The molecular weight of crystalline horseradish peroxidase. *Ark. Kemi. Mineral. Geol.*, B15: 1 (No. 24).
- . 1942b. The magnetic properties of crystalline horseradish peroxidase and some of its derivatives. *Ark. Kemi. Mineral. Geol.*, A16: 1-11 (No. 3).
- . 1942a. Preparation and properties of crystalline horseradish peroxidase. *Ark. Kemi. Mineral. Geol.*, A16: 1 (No. 2).
- . 1943b. The hemin protein linkage in hemoglobin and in horseradish peroxidase. *Ark. Kemi. Mineral. Geol.*, A16: 1 (No. 14).
- , and K. AGNER. 1943. Magnetic and other properties of crystalline horse-liver catalase and some of its derivatives. *Ark. Kemi. Mineral. Geol.*, A16: 1 (No. 7).
- , S. BERGSTROM, and A. ÅKESSON. 1943. Combination of peroxidase protein with various hemins. *Ark. Kemi. Mineral. Geol.*, A16: 1 (No. 13).
- , and K. G. PAUL. 1944. Dissociation constants and their relations to the activity in peroxidases. *Ark. Kemi. Mineral. Geol.*, A18: 1 (No. 12).
- VAN SLYKE, D. D. 1942. The kinetics of hydrolytic enzymes and their bearing on methods for measuring enzyme activity. *Adv. Enzymol.*, 2: 33-47.
- WARBURG, O. 1926. Über die Wirkung des Kohlenoxyds auf den Stoffwechsel der Hefe. *Biochem. Z.*, 177: 471-486.
- . 1938. Chemische Konstitution von Fermenten. *Ergebn. Enzymforsch.*, 7: 210-245.
- , and E. NEGELEIN. 1932. Über das Hämin des Sauerstoffübertragenden Ferments der Atmung, über einige künstliche Hämoglobine und über Spirographisporphyrin. *Biochem. Z.*, 244: 9-32.
- WEISS, J. 1946a. Simple electron transfer processes in systems of conjugated double bonds. *Trans. Faraday Soc.*, 42: 116-121.
- . 1946b. Electron transfer processes in photochemical oxidations and reductions. *Trans. Faraday Soc.*, 42: 133-139.
- WEISSBERGER, A., and J. E. LUVILLE. 1944. Oxidation processes. XVII. The autoxidation of ascorbic acid in the presence of copper. *J. Amer. chem. Soc.*, 66: 700-705.
- WOOLF, B. 1931. Addition compound theory of enzyme action. *Biochem. J.*, 25: 342-348.
- ZUIDEMA, H. H. 1946. Oxidation of lubricating oils. *Chem. Rev.*, 38: 197-226.



NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Assistant Editor of THE QUARTERLY REVIEW OF BIOLOGY, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.

REVIEWS AND BRIEF NOTICES

General Biology: Philosophy and Education.....	229	Animal Growth and Development.....	258
Biology: History and Biography.....	230	Animal Physiology.....	259
Ecology and Natural History.....	233	Animal Nutrition.....	263
Evolution.....	237	Biochemistry.....	264
Genetics and Cytology.....	237	Microbiology.....	265
General and Systematic Botany.....	239	Parasitology.....	267
Economic Botany.....	243	Health and Disease.....	268
General and Systematic Zoology.....	249	Psychology and Animal Behavior.....	273
Economic Zoology.....	256	Human Biology.....	281
Animal Morphology.....	256	Biometry.....	286
		De Omnibus Rebus et Quibusdam Aliis.....	287

GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

SCIENCE AND REALITY.

By T. Bedford Franklin. G. Bell and Sons, London.
3s. 6d. vi + 56 pp. 1947.

Somewhere the reviewer has read the statement that the modern scientist writes like a philosopher, and that the modern philosopher writes like a scientist. The author of *Science and Reality* disclaims being either a scientist or a philosopher, but he writes both scientifically and philosophically. His book takes the form of a dialog between a scientist and Mr. X, that searcher after knowledge created by Sir Arthur Eddington in *The Nature of the Physical World*.

The relationship between the scientist and Mr. X is not that of teacher and pupil. The scientist, like Mr. X himself, is conscious of his own intellectual limitations, and makes his contribution to the joint symposium with humility and reverence. He is not to be compared with Jonas in the Rollo books, or with Rosamond's mother in Maria Edgeworth's *Early Lessons*, but rather with the Canterbury pilgrim of whom Chaucer stated, "Gladly would he learn, and gladly teach." He welcomes Mr. X to the museum which he has been rehabilitating to make it conform

with the new quantum and relativity physics, and personally conducts him through room after room, explaining the exhibits. But he also gives Mr. X the opportunity to express his own opinions, and to offer suggestions, and listens courteously while Mr. X does so. Perhaps the participants are too polite to each other. Not that they resemble Gaston and Alphonse from the comic strip of an earlier generation, but merely that no issue between them is ever joined because there seems to be no issue that can be joined. For instance, in the penultimate chapter, where such a controversial subject as telepathy is considered, both participants admit the essential reasonableness of telepathic phenomena but both reject the demonstrations of telepathic communications given by professional clairvoyants. (Incidentally, is there such a word as telepathic? Should it not be telepathetic, after the analogy of sympathetic?)

The author has quoted extensively from Eddington, Jeans, and several less well known writers. Therefore perhaps he will permit one to quote from the final chapter of his work:

"Let us admit then that the ultimate reality is in the realm of the mind, for without mind the material world is purposeless and the spiritual world an unattainable ideal. The purpose of our life on Earth is the proper

use of mind, and the grafting on to our personalities of those values that come from the mind.

"To do this we have not got to be mathematicians, scientists, artists, poets, or philosophers or any of those people whom the ordinary man finds a little queer and incomprehensible. For the values to be sought are not mathematical formulae, scientific theories, or philosophical truths, but are simply Truth, Beauty, Goodness, and Love, and these are within the reach of us all."

To these words the reviewer repeats the loud Amen.



WHAT IS LIFE?

By J. B. S. Haldane. *Boni and Gaer, New York City.* \$3.00. x + 241 pp. 1947.

This book should not be confused with another bearing the same title, by Erwin Schrodinger, already reviewed in these columns. It is a strange coincidence that these two books should have appeared within a year of each other. The one under discussion here consists of a series of separate essays most of which had already been published in daily newspapers. With a single exception they are all very brief, and one of the briefest is that which gives its title to the collection.

The author makes no attempt to answer the question which he poses in this essay. This is not because we do not know enough about life, but because we know too much. The experience of being alive is so fundamental that it cannot be defined in simpler terms. A definition of life would inevitably be somewhat similar to Dr. Samuel Johnson's definition of *network*: "Anything reticulated or decussated with equal intervals among the interstices." But if life cannot be defined satisfactorily, living matter may, although the task may be somewhat difficult. Yet it must be attempted if we are to learn to think scientifically when we consider ourselves, either our separate physiological activities or our corporate social reactions.

The author is thoroughly convinced that the social and political dilemmas which confront the civilized world today cannot be solved by anyone whose thinking lacks a scientific foundation. This thought has been expressed by earlier writers, notably Karl Marx, Friedrich Engels, and especially by Patrick Geddes. The reviewer gets the impression that Haldane owes more of his philosophy to Geddes, whom he does not quote at all, than to Marx and Engels, whom he quotes extensively.

In the United States, where few read Marx and Engels at all, and still fewer read either with intelligence, it is not customary to speak of these writers except disparagingly; but Haldane, who understands them perfectly, is able to discuss them without giving way to hysteria. For this reason the book is profitable reading for Americans, even for those not interested in

the life sciences, and it deserves a wider circulation than it is likely to get.

Unfortunately, many of these essays were originally written some years ago, and have been reprinted here without the revision necessary to bring them up to date. For example, the author praises the Soviet Union for placing such an outstanding scholar as Vavilov in the presidency of the Soviet Academy, and he contrasts this action with that of the British government in forcing Harland, the leading geneticist of that nation, into exile in Peru, on grounds which a British jury held to be unjust. This comparison was justifiable when made, but it has subsequently become commonly believed, in this country at least, that as an aftermath of the controversy stirred up by Lysenko, Vavilov was sent to Siberia, where he died. If true, this would seem to indicate that in Russia politics thrusts its tentacles into the intellectual life of the people just as it does in England, or in our own country, as the persecution of Condon by the Thomas committee bears witness.

The only way to do adequate justice to a volume of this nature, from the pen of such a versatile genius as Haldane, would be to analyze each essay separately—but for such a task space and qualifications are lacking. Let it suffice to say that this is an extremely readable and withal important book, addressed not to the professional scientist but to the average reader, and expressed in language which does not degenerate to that level, affected by some popularizers of science, which insults the intelligence of its readers. Any one who undertakes to peruse this book will probably be as pleased with it as the reviewer has been.



BIOLOGY: HISTORY AND BIOGRAPHY

HOW MAN DISCOVERED HIS BODY. *A Young World Book.*

By Sarah R. Riedman; illustrated by Frances Wells. *International Publishers, New York.* \$2.25. 128 pp.; text ill. 1947.

This book is a companion to the two outstanding books for 12-year-olds by Alex Novikoff, *Climbing Our Family Tree* and *From Head to Foot*. Written in a lively but simple style, and illustrated with graphic skill and humor, Sarah Riedman's book undertakes to tell the history of physiology in a way to make young readers appreciate the nature and methods of science and the hard effort and struggle against prejudice and error that underlie our present attainments. The story begins with man's curiosity and the belief in the power of magic. It moves on to consider the Greeks, Hippocrates and Aristotle; then the influence of Galen and the thousand years of darkness. Vesalius, Harvey, Leeuwenhoek, Malpighi, Stephen Hales and Robert Hooke, Priestley and Lavoisier, Réaumur, Spallan-

zani, Wm. Beaumont, Schleiden and Schwann, Morton, Claude Bernard, Galvani, Ferrier, Magendie and Bell are high-lighted in a procession of numerous others leading to such modern figures as Cannon, Hill, Banting, Loewi, and Pavlov. "So the unfinished story continues," the author concludes by saying.

Unfortunately, the standard of factual accuracy is not as high here as in Novikoff's companion books. The author has in several places said just the opposite of what she presumably meant. For example, William Harvey by dissection "... plainly showed that the veins on the right connected with the lungs, the ones on the left with the rest of the body." That is going to lead to no end of confusion in the mind of a 12-year-old reader! Again, "when this diaphragm and the muscles of the chest shorten, they pull on the covering of the lungs and make them stretch," is wording which would seem to imply that the diaphragm is directly attached to the lungs. And Leeuwenhoek, who wrote so many excellent, detailed letters about his observations to the Royal Society, would surely have been shocked to learn that a later generation would be told that "he refused to share his observations... [because] he did not know how to write well." Such lapses are fortunately not too numerous; but they detract from an otherwise notable piece of science writing for the young.

BENTLEY GLASS



APERÇU DE L'HISTOIRE DE LA MÉDECINE EN BELGIQUE.
Collection Nationale, Seventh Series—Number 84.

By Ernest Renaux, Albert Dalcq and Jean Govaerts.
Office de Publicité, Bruxelles. 25 fr. (paper). 84 pp. + 8 plates. 1947.

This little volume contains three short and competent essays on the development of the medical sciences in modern Belgium (which originated in 1831). The first division (by Dalcq) deals primarily with the remarkable work in embryology and cytology carried out by E. van Beneden, A. Brachet, and their pupils and contemporaries. The second division (by Govaerts) is devoted to modern Belgian surgery (E. Lambotte, and others). The third, Medicine and Experimental Sciences, by the editor E. Renaux himself, emphasizes the great contributions to practical and theoretical hygiene made in the pre-bacteriological era and later that are characterized by the names of Mayenne, van Ermengem, Malvoz, Bordet, and Gengou, among others. The fine physiological accomplishments of L. Frederic, P. Heger, etc., are shortly described. The importance of research in pure science for the development of practical medicine is stressed throughout the book. The little country has no dramatic invention to show, but in assimilating the best suggestions of her German and French neighbors, she has

made a great number of very valuable contributions to science and has succeeded in maintaining unusually high standards. The booklet itself reflects this character of Belgian medical science.

ERWIN H. ACKERKNECHT



DOCTOR, DON'T LET ME DIE!

By S. S. Keiner; with the collaboration of Dan Gorden.
Meador Publishing Company, Boston. \$3.50. 486 pp. 1947.

This is an autobiographical novel, the story of an average big city general practitioner, his studies, his internship, his state board, the hungry first years, the patients, and so on. Everything looks cheap about this book to start with: the dust cover, the paper, the pompous dedication. And then one begins reading it, and cannot stop. The author is no great writer either, in the conventional sense. But with savage honesty he succeeds in giving so vivid a picture of all that is great and foul, sad and gay in this profession of ours in these days that at least most of those who have known, suffered, and loved medical reality will be fascinated and deeply moved. I have no doubt that this book contains more historical truth for future generations than a whole wagonload of the fashionable, fine biographies of contemporary medical leaders.

ERWIN H. ACKERKNECHT



DOUGLAS OF THE FIR. *A Biography of David Douglas, Botanist.*

By Athelstan George Harvey. Harvard University Press, Cambridge. \$4.00. x + 290 pp. + 6 plates; text ill. 1947.

David Douglas was one of a galaxy of brilliant explorer-naturalists produced in the British Isles during the late 18th and early 19th centuries. He was a contemporary of John Richardson, Thomas Drummond, John Franklin, Edward Parry, and George Back. These were the men who gathered the original material upon which our knowledge of the natural history of boreal and western America is based. The stirrings that took them afield were not limited to interests in natural history in the strict sense, but extended to the kindred spirits who carried the fur trade into the far Northwest—men such as Alexander Mackenzie and David Thompson. Even in so colorful a company, David Douglas was a brilliant figure into whose short tragic life was packed a volume of accomplishment, acclaim, and troubles not visited upon many men. He was killed in Hawaii in 1834, at the age of 35. In the twelve years between 1823 and 1835, he travelled extensively in eastern America, in the Columbia and Fraser River regions, in California, and in Hawaii.

He introduced 215 useful and ornamental plants to British gardens, and made extensive specimen collections of the flora, fauna, and minerals of the lands he visited. On one occasion he returned to England from the Columbia by way of Hudson Bay, travelling mostly afoot across the Rocky Mountains and the Canadian plains.

A. G. Harvey's biography is concise, well written, and splendidly documented. One wishes at times that he had developed the character of Douglas a little more freely, instead of leaving the reader to peer through and between the lines for glimpses of the actual man. This shortcoming, however, is adequately counterbalanced by the author's dispassionate treatment of the theme as a whole. One finishes the book with the feeling that he has been given, in an entertaining manner, all of the facts from which to build an acquaintance with a striking figure in botanical and exploratory history.

H. M. RAUP



TWO BLADES OF GRASS: A History of Scientific Development in the U. S. Department of Agriculture.

By T. Swann Harding. University of Oklahoma Press, Norman. \$3.50. xvi + 352 pp. 1947. The author, a veteran writer and employee of the Department of Agriculture, has recorded the more valuable and sensational achievements of the Department's scientists from the early beginnings up to the present time. The history of the scientific agencies of the Department, and brief biographical sketches of some of the prominent scientists, are given. The work of famous men, including Theobald Smith, Marion Dorset, Maurice C. Hall, Harvey W. Wiley, Lore A. Rogers, Erwin F. Smith, M. B. White, L. O. Howard, W. O. Atwater, M. A. Carleton, and many others is given in considerable detail. The reader is regaled with a recital of the discoveries that led to the control of cattle tick fever, hog cholera, hookworm, and of many plant diseases. The introduction of numerous valuable plants, including Korean lespedeza, Acala cotton, Sudan grass, mosaic-resistant sugar canes, crested wheatgrass, Ladino clover, and Chinese (Mongolian) elm are listed. The breeding of hybrid corn and of disease-resistant varieties of wheat, oats, flax, cotton, sugar beets, and potatoes are recorded. Among the numerous scientific discoveries noted are photoperiodism, the technics of manufacturing sweet cream butter and Swiss cheese, and fermentation processes for making citric and gluconic acids. Items that are of more recent interest include the contributions of the Department to the application of D.D.T., penicillin, and 2,4-D. Researches in soils, forestry, wild life, and fertilizer manufacture are described. The genesis of the Pure Food Laws is recorded.

It is unfortunate that the shortness of the book did not permit mention of innumerable other important achievements. Topics omitted include the classic researches on soil moisture utilization, the establishment of scientific facts on dry farming to replace a host of impractical theories, the development of rices of superior cooking quality, the extension of flax, rice, and grain sorghum into new regions, the control of field bindweed, the determination of poisonous range plants, the breeding of crop varieties to fit them to machine harvesting, the breeding of smooth-awned barleys, and many others. The book includes no mention of the economic researches, even those of W. J. Spillman and O. E. Baker and their associates.

The book is surprisingly free from errors of fact and spelling. Among the discrepancies observed were a reference to the introduction of "upland" rather than lowland rice (p. 102), the crediting of research on apples to L. L. Harter instead of M. H. Haller, and the relegation of the latter, a contemporary worker in his prime, to the historical past.

Probably few research scientists in the Department will agree with the author's evaluation of the different administrations with regard to the encouragement and support of their work. Nonetheless, the author has prepared a valuable chronicle of progress in American agriculture.

JOHN H. MARTIN



MAYA EXPLORER: John Lloyd Stephens and the Lost Cities of Central America and Yucatan.

By Victor Wolfgang Von Hagen. University of Oklahoma Press, Norman. \$5.00. xviii + 324 pp. + 40 plates + 1 map; text ill. 1947.

This is the very entertaining, excellently written biography of a remarkable person who greatly stimulated the rise of American archeology. John Lloyd Stephens, an adventurous New York lawyer, business man, traveler, and diplomat, over a century ago rediscovered many of the now famous ancient centers of Mayan culture in Central America. As a young man he travelled to Greece, Egypt, and Arabia and in the latter part of his life he took a leading part in the construction of the Panama railway. He was born in New Jersey in 1805 and died in New York in 1852. Stephens' accounts of his Central American explorations, published in 1841 and 1843, created a tremendous interest in New World archeology, their appeal having been greatly enhanced by the many charming, remarkably accurate and detailed drawings, made by Stephens' faithful companion, the English artist Frederick Catherwood.

Even though the life of Stephens cannot be reconstructed completely, since many of his journals and much of his correspondence have become lost,

Von Hagen has succeeded admirably in bringing his hero back to life, giving him well deserved praise, and picturing vividly the romance and difficulties in the early exploration of the vanished Mayan civilization in jungle-hidden ruins. The text is enriched with 40 pages of fine illustrations from Catherwood's drawings and from modern photographs of corresponding scenes. There is a brief chronology of Stephens' life, an extensive bibliography, and an adequate subject index. Students of American archeology and all travelers to Central America will want to read this book and can be assured of pleasure and profit.

A. H. SCHULTZ



ECOLOGY AND NATURAL HISTORY

ONE DAY AT TETON MARSH.

By Sally Carrighar. Illustrations by George and Patricia Mattson. Alfred A. Knopf, New York. \$3.50. viii + 239 pp. + 9 plates; text ill. 1947. Like *One Day on Beetle Rock*, Sally Carrighar's first rich and delightful book of natural history, *One Day at Teton Marsh* portrays the same day in the lives of the animal habitants of a beaver pond and marsh alongside the rushing Snake River. Otter, cutthroat trout, and osprey appear first, followed by an interlude filled with the lives of tiny denizens of the willow cove—the mosquito and the scud. Mink, varying hare, merganser, and moose then play out their roles. Between acts the clepsine leech, leopard frog, and physa snail enact a lesser drama on the stage of a water-lily stalk and pad. The two final figures are the trumpeter swan and the beaver. The episodes reach a common climax in the animals' struggles to meet the crisis brought about by the fall of the dead cottonwood tree that supported the beaver-dam and the rapid emptying of the pond and draining of the marsh as a sequel.

The minute detail of the author's observations of these lives reveals a real naturalist, and the clarity and simplicity with which the author portrays them, free of human bias, is in the spirit of Henri Fabre. The closely interknit lives of these co-dwellers in the marsh blend in an ecological masterpiece that is as far as the Antipodes from the dullness of ecology textbooks. Descriptive biology is commonly regarded as outworn, dull, and unfruitful—and so much of it is. But this too is descriptive biology, and would that there were more of its like, in textbooks as well as out!

If there is a flaw in so fine a work, it is that of too evident a striving for fine language. At its best, Sally Carrighar's style is as fresh and full of tang as the air of the Tetons. Occasionally, in this book more than in her first, she strains for effect, becomes over-precious in choice of words or unusual sentence structure. Yet in other ways, *One Day at Teton Marsh* surpasses the

earlier companion volume. There is more drama in these episodes, more unity in the conception as a whole, an intenser feeling of life. The woodcuts add much to the charm of the book.

BENTLEY GLASS



ANIMAL HOMES.

By George F. Mason. William Morrow and Company, New York. \$2.00. 96 pp.; ill. 1947. The diversity of animal homes is great. The dens of the larger animals, the burrows of the fox, the woodchuck, and the mole, the lodges of the muskrat and the beaver, the gall homes of insects, and the pebbly tunnels of the caddis fly larvae all reveal to an observer something of the habits, the needs, and even the personalities of their occupants. Through simple sketchings and words, George Mason has revealed much of the family life of the commoner American animals above, on, and below the ground and water levels. Written for junior readers, the slender volume gives a straightforward and factual, but never sentimental, account of the author's observations and excavations. It is a book that has much to recommend it.

C. P. SWANSON



CONTRIBUTION À L'ÉTUDE DU PEUPLEMENT DES ILES ATLANTIDES. Société de Biogéographie. Mémoires—VIII.

By P. and Mme V. Allorge, A. Badonnel, A. Balachowsky, L. Berland, L. Bertin, J. Bourcart, P. Bourrelly, A. Chevalier, L. Chopard, J. Denis, J. Feldmann, E. Fischer-Piette, P.-H. Fischer, A.-L. Guyot, R. Jeannel, P. Jovet, Mme S. Jovet-Ast, P. Lester, E. Manguin, P. Marie, A. Mèquignon, Mme L. Paulian de Félise, P. de Peyerimhoff, R. Potier de la Varde, J. Rouch, M. Sorre, Mme Tardieu-Blot, D.-L. Uyttenboogaart, G. Viennot-Bourgin, R.-G. Werner. Paul Lechevalier, Paris. 1,600 fr. viii + 500 pp. + 13 plates + 2 maps + 1 chart; text ill. 1946.

Geography, geology, climatology, ethnography, zoology, and botany are represented in this collection of papers dealing with the Azores, Madeira, Canary, and Cape Verde Islands, and the small islets that surround them. The term oceanic island is used in a sense different than that in which Wallace originally defined it. The present definition limits this term to islands whose origin is bound with the formation of an ocean and which, at the beginning, had a connection with a continent. Volcanic islands are those that arose from the ocean depths and never had a continental connection. The Cape Verde, Canaries, and the Madeiras are considered continental, but the

Azores, oceanic. The geological history of these islands is discussed at great length and their physical structure is described in great detail, with maps for each island indicating stratigraphic formations. This information plus data on the climatology and oceanography of the area constitute the subject matter of the first three papers.

The remainder of the contributions are concerned with the faunistics of the islands, which have been studied with the hope of confirming or amending the geological evidence on the past history. With this view in mind the island faunas have been carefully compared with those of Europe, Africa, and North America. Unfortunately, there is still too little known on the zoology and botany of these areas as a whole—only certain groups have been fairly satisfactorily studied, and again, not equally well on all islands.

The invasion of these islands by man and the origin of these primitive inhabitants is the topic of the first paper on faunistics, which is followed by a second paper containing a similar discussion of the poikilotherms. The Coleoptera, which, of the invertebrates, seem to have been the best studied, is the topic for the next three papers. Following this are given the results of studies on the Orthoptera, Coccoidea, spiders, psocids, isopods, mollusks, Foraminifera, ferns, mosses, and algae. In the latter, incidentally, algologists will find some new forms described. To generalize the results of these studies would bring out multitudinous data that in itself would make a lengthy paper. To take an example from the cold-blooded vertebrates: there are no fresh-water fish on the islands except for the eel; no amphibians on the Cape Verde group, and only introduced species on the others; no snakes; only marine turtles (one doubtfully endemic species); many lizards. The latter include 29 species and subspecies of lacertids, skinks, and gekkos. A study of their distribution indicates that the Azores separated from the continent early (in the Oligocene or early Miocene) and did not profit from the rapid evolution of reptiles and amphibians that occurred later in Europe and Africa. The Madeiras and the Canaries have a predominantly Mediterranean fauna and the Cape Verde Islands an Ethiopian; these two groups separated early from each other. As a whole, the biota are more like the nearest continents than they are among the various islands, and they speak for different modes of invasion.

It is needless to point out that those interested in geology and zoogeography will find this publication a necessary reference. Although many of the discussions, especially those dealing with links to the West, are extremely valuable, the general impression is that there is still plenty of research remaining to be done in order to reach any final decision.

HENRI C. SEIBERT

DESERT PARADE. A Guide to Southwestern Desert Plants and Wildlife.

By William H. Carr; photographs by Marvin H. Frost. The Viking Press, New York. \$2.50. 96 pp.; ill. 1947.

Desert Parade consists principally of brief notes on the habits and characteristics of some of the more common mammals, birds, reptiles, arthropods, and plants of the deserts of southwestern United States. It is illustrated with excellent photographs by Marvin H. Frost. The end papers carry a map of the Southwest showing desert areas, national parks and monuments, and principal highways. A few useful reference books are listed, and on the last page of the book is a brief discussion of the climate. The partial nature of the book is indicated by the fact that only about 200 species are mentioned, about 85 per cent of which are plants.

H. M. RAUP



PLANTS AND ENVIRONMENT. A Textbook of Plant Autecology.

By R. F. Daubenmire. John Wiley and Sons, New York; Chapman and Hall, London. \$4.50. xiv + 424 pp.; ill. 1947.

According to the author's preface, "this book is an outgrowth of ten years' experience in teaching the fundamental relations between plants and environment to mixed classes of students majoring in botany, forest management, range management, and agriculture." The subject is approached through individually considered major environmental factors and the relations of plants to each of them. The point of view is that of practical field ecology, but with adequate regard for fundamental and theoretical aspects of factor relations. The text is thus one of autecology, which the author defines as "a consideration of those phases of geology, soils, climatology, zoology, chemistry, and physics which are more or less directly connected with the welfare of living organisms, and a relating of them to the structure, function, and evolution of [plant] species." This pronouncement is of course more inclusive than the text which follows. Daubenmire excludes "the several conflicting philosophies of plant sociology," and states what should be a truism in ecological teaching if it is not, that the study of plant communities must rest on "a working knowledge of the basic interrelationships between the individual plant and environment."

More than three-quarters of the text is devoted to soil, water, temperature, light, and atmospheric factors. The author's discussions of these factors are well organized, concise, and clear. Those fundamentals of soil science, meteorology, climatology, and physics vital to the work of the field ecologist are reviewed.

Thus, although the organismic relations to environment dealt with here are those of plants, chapters on the aforementioned factors will be useful to students of animal ecology as important background information. There follow short chapters on biotic and fire factors and a brief terminal consideration of factor interrelations, "the environmental complex." The last chapter, *Ecologic Adaptation and Evolution*, although reading somewhat more like an addendum than an integral part of the text, serves to introduce the student to evolutionary aspects of ecological problems, mainly through the important recent work on plant ecotypes.

The basic approach of this text is essentially that of other recent ones which deal with plant autecology. Thus, no new contribution to the conceptual organization of the field has been made. But in avoiding controversial terminology and tenuous theory, the author has done a real service to teachers of ecology. Yet his attitude in this respect seems at times to have been too rigorous—for instance, although subject matter relating to vegetational change or succession is discussed by the author, I do not find the term "succession" used in the text, and it is not included in the index. This may be more of a hindrance than a help, as the term is both well established and useful. Also, the value of the text would have been enhanced by a descriptive chapter, even a brief one, on North American vegetation. To the reviewer, such a chapter seems as appropriate to a text on plant autecology as the terminal one on evolution. A field ecologist cannot avoid thinking in terms of natural vegetational units and here, controversial theoretics notwithstanding, the student must appeal to other sources.

Minor errors in text are few. Repetitions of fact, such as those on the value of data of mean annual temperature (pp. 183, 194) and the significance of low-temperature exposure to temperate-region perennials (pp. 196, 198), could have been avoided. At two points in chapter 9, except for different introductory sentences, text of more than a page-length is duplicated under two different headings. The illustrations are well chosen and clear. There is a 14-page index and a bibliography of 612 titles.

FRANK A. PITELKA



LE CLIMAT ÉCOLOGIQUE de la Cuvette Centrale Congolaise.

By Étienne Bernard. *L'Institut National pour l'Étude Agronomique du Congo Belge, Bruxelles.* 300 fr. (paper). 240 pp. + 1 chart, 2 maps; ill. 1945.

The Congo Basin is a region situated between 16° and 26° E longitude and 4° N and S latitude, with an elevation that rarely exceeds 500 meters. This de-

pression is covered by an immense forest forming a fairly homogeneous band of vegetation. Since nothing, aside from local sporadic observations, is known regarding the climatology of this particular area, the present data, collected from a series of stations scattered over the Basin, provide much needed information.

Considerable emphasis has been placed on the energy of radiation, a factor of great ecological import, though too often neglected. Because of a rather high opacity, due to water vapor and impurities in the air, and a comparatively high nebulosity, the radiation values in the Congo Basin are scarcely greater than those found in temperate latitudes. The air temperature cycle has maxima at the equinoxes and minima at the solstices, being 31° and 20°C. respectively. Extremes rarely pass 36° and 17°C. Data on other important climatic factors, such as precipitation, evaporation, water vapor, and wind currents, are also included in the publication and are presented in the form of charts, tables, and diagrams. Each topic is thoroughly discussed. For such a large area, more first class observation stations would have been helpful, but the compiler seems to think that this fault is more or less alleviated by the general uniformity of the climate. It is to be hoped that this project will be continued with its present detailed objectives and that some of the difficulties encountered in making these original observations will be smoothed out. There is an extensive bibliography, an index, and two insert maps, one showing the geographic features of the Basin, and the other showing the climatic zones of Köppen. The latter appear to coincide well with the vegetational facies.

HENRI C. SEIBERT



CHEMICALS, HUMUS, AND THE SOIL. *A Simple Presentation of Contemporary Knowledge and Opinions about Fertilizers, Manures, and Soil Fertility.*

By Donald P. Hopkins. *Chemical Publishing Company, Brooklyn.* \$8.50. x + 358 pp. + 1 plate; text ill. 1948.

About 20 years ago Albert Howard was director of the Indore Experiment Station, Central India, where cotton improvement was the main activity of the Station. Compost-making for soil improvement was extensively studied and later became known as the Indore method. Sir Albert lectured and wrote extensively to advocate the making and use of composts for maintaining soil fertility. He was bitterly opposed to the use of mineral fertilizers, believing that their use was the cause of insects and pests, low nutritional value of the plants grown with fertilizers, etc. He and his disciples completely disregarded scientifically proven findings to further a crusade based on subjective

rather than objective reasoning. An American writer of this school was complimented by Sir Albert for writing audaciously! Not much else can be said in favor of much of the propaganda published by the group.

The book under review is also from Britain, written clearly and simply, though by a chemist. It is a presentation of contemporary knowledge and opinions about fertilizers, manures, and soil fertility. The style is refreshing. The author first presents the case for fertilizers, showing what they can and have done for modern agriculture, and how we could not produce needed crops without their use. Then, when considering the case against fertilizers, he points out that organic matter or humus in the soil is essential for maintaining fertility and satisfactory soil conditions. Even a brief consideration of the facts and arguments presented makes it clear that Sir Albert and his school have not dealt honestly with well established scientific facts. This is a book which can read with profit by all amateur gardeners.

ROBERT L. PENDLETON



MOTHER EARTH. *Being Letters on Soil Addressed to Sir R. George Stapledon.*

By Gilbert Wooding Robinson. Thomas Murby and Company, London. 9s. 6d. viii + 201 pp. + 1 plate + 2 maps; text ill. [1937] 1947.

It is indeed a pleasure to welcome this new edition of so delightfully written and withal so informative a book. The ease and pleasure of reading is enhanced by the essays being cast in the form of "Letters on Soil" which are addressed to a well-known pasture specialist. These essays are authoritative, for the author is one of the most competent soil scientists in the British Empire. This is a "book in which the essential knowledge about soils is presented in clear perspective; a book that will give workers in other fields, geologists, geographers, ecologists, agronomists, and Directors of Plant Breeding Stations, all they need to know for the benefit of their own studies." But the book should also interest the general reader, perhaps even the farmer and landowner, in the story of the soil. The author has not attempted to write a concise manual of soil improvement. Rather, it is a series of essays on the soil viewed from a philosophical standpoint, since this is believed to be the only approach which gives any hope of real progress. On the other hand, the vigorous propaganda which has recently been directed against artificial fertilizers, particularly in Britain, has led to a strongly worded postscript to one of the Letters, which reads in part as follows: "It is asserted with almost mystical fervor that [artificial fertilizers] affect adversely both soils and crops, and that foods produced by their aid are injurious to animal and

human health. Such ideas make a natural appeal to the credulous, but actually the evidence adduced will not bear examination."

ROBERT L. PENDLETON



WING TO WING: Bird Watching Adventures in Five Countries.

By E. H. Ware; illustrated by Roland Green. Harper & Brothers, New York and London. \$2.75. 159 pp. + 16 plates; text ill. 1946.

When the author enlisted in the RAF at the beginning of the last war, he resigned himself to the belief that his bird watching activities would be curtailed for the duration. Much to his surprise and greatly to his delight, however, he discovered not only that there was opportunity to carry on his hobby between stretches of duty, but also that his new career and its attendant travels enabled him to visit foreign lands and to study strange birds. First stationed in England, in Essex, the author observed several birds he had not seen before around his home in Devon. This stay was interspersed with weekend trips to neighboring areas and a seven days' leave to the Scottish Highlands. Then came overseas duty to Algiers, Tunisia, and finally Corsica.

In among the bird notes are descriptions of army life, including the humorous and the monotonous. It is evident that boredom was not in the author's repertory; for so long as he had his field glasses he could contentedly pass away any part of the day. Unfortunately, during his five years' hitch he never encountered another bird student who could share his enthusiasm. Those who like to read about birds and who enjoy searching for and finding new species for their life list will derive much vicarious pleasure from this book. It is illustrated with photographs by the author and sketches by Roland Green.

HENRI C. SEIBERT



AN ANNUAL CYCLE OF THE PLANKTON AND CHEMISTRY OF FOUR AQUATIC HABITATS IN NORTHERN FLORIDA. *University of Florida Studies, Biological Science Series, Volume IV, Number 3.*

By E. Lowe Pierce. University of Florida Press, Gainesville. \$1.60 (paper). xii + 67 pp. + 2 charts; text ill. 1947.

As compared with more northern areas, the inland waters of Florida are more uniform, especially in their temperature and dissolved oxygen content. The relation between these factors is inverse. The entomostraca population showed no pronounced fluctuation, but seasonal pulses of rotifers and definite phytoplankton pulses occurred.

EVOLUTION

OUR FLOWERING WORLD.

By Rutherford Platt. Dodd, Mead and Company, New York. \$6.00. viii + 278 pp. + 8 plates; text ill. 1947.

The evolution of the flowering plants presents, even with the many gaps that still exist, one of the most fascinating stories of all times, yet to the layman it is a closed and unintelligible one. Hidden in forbidding technical volumes, and clothed in botanical jargon, it has lacked a champion who could disclose it in its proper setting for everyone to view. Rutherford Platt has taken this task upon himself, and to state that he has succeeded admirably is to make an obvious understatement. With simple words and a series of remarkable black-and-white and colored photographs, Platt carries the reader through the ages, viewing the varied scenery, and spying on the natural processes that are slowly but inevitably forcing change upon the earth and its floral inhabitants. One needs no training in the botanical sciences to appreciate that time has no meaning, or that adaptive perfection is the only goal whose attainment is a necessary prerequisite for continued existence. In his handling of the floral magnificence of the Carboniferous, and of the evolution of the angiosperm flower and herb, Platt has given to botany a type of literary exposition which the textbook writers would do well to imitate.

It is only when the author begins to interpret evolutionary changes that he falls into serious error. The theory of Gondwanaland and the meaning of the distribution of the fossil *Glossopteris* are stated with a finality that would most certainly be disputed by geologists and botanists alike. His teleological and Lamarckian reasoning likewise carries him far astray. He seeks a "creative spirit" to account for the changes in plants, and this he finds in climatic pressures when he points out that "important changes in plants result from changes in climate" and "when pressures come along, protoplasm immediately responds." He again elaborates on this theme by stating: "From the first alga to the cattleya orchid, from the dawn-seed fern to the flowering dogwood, the simple laws of life and growth have never been violated...The sensitive controls of this mighty mechanism are temperature and moisture. Climate was the architect of *glossopteris* just as it is of trailing arbutus and blueberries." Genes are mentioned once in the text. Platt similarly misinterprets the Darwinian theory of evolution, giving to it a Lamarckian twist. "According to this [Darwin's theory], the living cell takes all sorts of chemical and structural steps, and that which brings the organism into the best balance for living is retained and becomes an improvement that is incorporated into the chromosomes and passed along to future generations." This is obviously putting the cart before the horse, if we are to accept the experimental data which

have flowed from the biological laboratories since the time of Darwin.

Despite these errors of interpretation, this is the kind of book which brings to botany a fresh and uncluttered point of view. No one who reads the volume and again views a ginkgo will forget that "it is a transition, a moment in evolution caught and fixed in mid-course." Or that plant evolution is a timeless "assembly line" where "accessories are added, or parts are subtracted." We can accept or reject, as our background and training permits, the teleological interpretation of the author as to the "whys and wherefores" of organic existence.

C. P. SWANSON



GENETICS AND CYTOLOGY

INTRODUCTION TO GENETICS AND CYTOGENETICS.

By Herbert Parkes Riley. John Wiley and Sons, New York; Chapman and Hall, London. \$5.00. xii + 596 pp.; ill. 1948.

As presented to undergraduate students, genetics may be introduced as an abstract science obeying the laws of probability, or as one aspect of a two-sided phenomenon in which the abstract considerations have been shown to possess a physical counterpart in the behavior and structure of the chromosomes and the cell. Riley, being a cytologist, has chosen the latter method, and in his recent book has made an attempt to weld the abstract and physical aspects of the problem into an organic whole by an emphasis upon the chromosomal mechanism of inheritance. The desirability of this approach is obvious, if not necessary, for the marriage of genetics and cytology has been a fertile one, even though one not always characterized by connubial bliss. The presentation of material in Riley's book is not a novel one, but the comprehensive treatment of cytogenetic data has been a long-felt need. That the task is formidable few will deny; that this volume meets the need, however, is rather questionable.

As a textbook, it must be judged by two criteria: the contents, and their presentation. As to contents, Riley has succeeded in incorporating a tremendous amount of factual material. A more judicious selection of material for illustrative purposes would have greatly improved the volume; certainly much that is desirable in the cytogenetic picture has been omitted. The gene-deficiency relationships in chromosome 9 in maize and in the Notch series in *Drosophila*, the considerable research on chromosome chemistry, the genetic studies on microorganisms, and the intrachromosomal relationships of crossing over, for example, are scarcely mentioned, if at all. The first five chapters could well have been compressed or incorporated into other chapters. Since genetics is generally presented as a semester course, it is doubtful whether all of the material can be

covered, and the student is rarely able to make a proper selection when given a choice.

As to presentation, the book has been divided into four sections: 1) an introductory survey of five chapters; 2) eight chapters devoted to gene transmission; 3) ten, to the nature and physiology of the gene; and 4) seven, to chromosomal aberrations and evolutionary processes. These are broad divisions with considerable overlap, and there are some obvious, though not serious, inconsistencies. While the order of presentation will depend upon the individual author, and Riley's sequence is a reasonable one, a criticism can be leveled at the manner of presentation. Lacking in clarity and integration, the disjointed and almost reportorial treatment will cause the student trouble in relating the fundamentals of genetics to the more technical aspects of cytogenetics. One reads with the feeling that Riley simply abstracted those articles which he felt to be important, conveniently grouped them into chapters, but forgot to knit them into a whole fabric. The author likewise has the mistaken notion, thus ignoring a vast amount of data, that because the Darlingtonian hypotheses of chromosome mechanics are beautifully logical they are therefore scientifically correct. Not only has the heart of the cytogenetical subject been given a biased presentation, but the student is given a false sense of scientific security which will not stand him in good stead for advanced work. The student who ingests this mass will find it exceedingly difficult of digestion.

The over-all result is a volume that, while urgently needed, is still neither a good elementary textbook nor a usable reference. The subject matter still awaits an interpreter.

C. P. SWANSON



HOW LIFE IS HANDED ON.

By Cyril Bibby. *Emerson Books, New York.* \$2.00. 159 pp.; ill. 1947.

There is a great need for a book just like this. Teachers and parents still shy away from sex instruction and leave it to the children to pick it up from one another. How much better this forthright discussion in language a 10-year-old can understand! Cyril Bibby is an Englishman, a fact worth note—one must still go abroad to find a qualified teacher with sufficient courage and enterprise to undertake sex education at the really appropriate age level.

The discussion itself is biological in tone and accurate as to fact. The drawings are clear and graphic, and every question about reproduction likely to occur to the mind of a 10-year-old seems to have been anticipated. There is no dodging of legitimate curiosity—no beating around the bush for bees and butterflies. The story of reproduction is handled in a comparative way,

with main emphasis on mammals, and especially the human species. The role of genes and chromosomes is clearly explained in a very simple manner. The chapter on The Declining Birth Rate is a model for discussions of population problems and eugenics—and unlike many American editions of foreign books, has really been rewritten for Americans. Appendixes contain Questions and Answers, well-chosen Things to Do, a list of Other Books to Read and Some Films to See, and a glossary. The solitary imperfection noticed in an otherwise flawless book was the overemphatic nature of the negative answer given to the question: "Can you inherit tuberculosis?" All in all, the book fully deserves a Gold Seal of Merit for biological books written for the younger generation.

BENTLEY GLASS



HOW TO BREED DOGS. *A Popular Exposition of the Scientific Principles Underlying Reproduction and Heredity in Dogs, with Special Reference to their Practical Application. Revised Edition.*

By Leon F. Whitney. *Orange Judd Publishing Company, New York.* \$4.50. xviii + 418 pp.; ill. 1947.

This is a popular exposition of the scientific principles of dog breeding. It is written and illustrated in a style which should make it easily understood by the layman. Accuracy seems reasonably high, but in some cases there is a tendency to oversimplify things. For example, cell division is much more complicated than one might be led to believe by reading the second chapter of the book. In a later chapter, on twins and litters, a method of obtaining greater size in dogs is given. This consists of producing two inbred strains and then crossing them. This method would not necessarily give dogs that were larger than the original stock, and the difficulty of producing two highly inbred lines is treated lightly. In the entire book comparatively little emphasis is placed on selection.

The book is divided into four parts and contains forty-three chapters. Part One is mainly on physiology and practical problems of reproduction. A brief anatomical description of the male and female reproductive organs is given, and the mating cycle of the female is well described. The most opportune time to mate is about the fourteenth day after the first signs of bleeding. How to detect pregnancy by palpation at three weeks is described. The sex hormones are treated briefly; however, the use of progesterone in postponing the mating cycle is mentioned. The most extreme case of prolificacy mentioned is that of a bitch which whelped 129 puppies in her first eight litters.

The second part of the book starts with a simple discussion of the principles of heredity and Mendelism. It is emphasized that germ plasm changes by mutation

and not by the inheritance of acquired characters, maternal impressions, birth marks, or by telegony. The inclusion of such a discussion for the layman seems appropriate. Sex determination is described briefly. In connection with quantitative methods such things as progeny tests and pedigree records are mentioned, but little is done toward explaining and applying them.

Part Three is much the largest part of the book. It treats in some detail the inheritance of coat color, coat characteristics, eye color, and tail characteristics. Mental aptitudes, body form, and disease resistance are discussed briefly. A summary of the color genes is included in the chapter on the knowledge of dog genetics up to 1937. Under mental aptitudes, the gene for open trailing is stated to be dominant to that for mute trailing. Many other interesting cases are reported. Whitney is of the opinion that one selects against intelligence when one disposes of the fence climbers, etc. In his kennels, the English type bloodhound lost every pup to Carre distemper, whereas the American bloodhounds lost only fifty per cent. Certain diseases seem to be more prevalent in certain breeds, as scotch itch in Scotch Terriers.

The last part of the book consists of pertinent advice to persons who may wish to start the dog hobby. If one does not have ample means it would be wise, the author says, to buy a female which is a poor specimen from a great family and to breed her to a male who has produced uniformly good offspring. He bases this advice on the fact that exceptionally good individuals seldom produce offspring as good as themselves and seldom do poor individuals produce offspring as poor as themselves.

The dog breeder will find this book to hold a wealth of information, presented in a form very easy to understand. The geneticist will find it a good source of dog genetics, although he may wish also to consult the original papers.

ROBERT W. TOUCHBERRY



GENERAL AND SYSTEMATIC BOTANY

THE LIFE CYCLE OF A PLANT. *A Work Book in Botany.*

By F. Whitwam Jones. J. M. Dent and Sons, London. 1s. 8d. (paper). 64 pp.; ill. 1946.

This is a unique laboratory manual in that most of the illustrations to be labelled are natural photographs rather than the diagrammatic line drawings which so many students find it difficult to understand. Many of the reproductions are too poor to be useful, however. While well prepared, and carefully written, its limited scope tends to restrict the usefulness of the manual in a general science program.

C. P. SWANSON

LABORATORY MANUAL OF ELEMENTARY BOTANY. *Second Edition.* McGraw-Hill Publications in the Botanical Sciences.

By Arthur W. Haupt. McGraw-Hill Book Company, New York and London. \$1.25. x + 79 pp. 1946.

The second edition of this manual is designed to meet the changes incorporated into the second edition of Haupt's introductory text. It is adaptable as a one- or two-semester laboratory manual, and it appears to satisfy the requirements of most elementary botany exercises without keeping the instruction on too rigid a basis.

C. P. SWANSON



NORTH AMERICAN SPECIES OF MYCENA. *University of Michigan Studies, Scientific Series, Volume XVII.*

By Alexander H. Smith. University of Michigan Press, Ann Arbor; Geoffrey Cumberlege, Oxford University Press, London. \$6.00. xviii + 521 pp. + 99 plates; text ill. 1947.

The book defines the genus *Mycena* in the widest sense, the author including even more groups of agarics in it than Fries and Saccardo did. A short history of past research on *Mycena* in North America, an interesting discussion of the diagnostic characters, and a review of the accepted classification (the author divides *Mycena* into 17 sections and a number of subsections and *stirpes* which are all grouped within the four main subgenera: *Pseudomycena*, *Eumycena*, *Glutinipes* and *Mycenella*) form the chapters that make up the introduction. The main part of the work consists in a complete taxonomic treatment of the temperate species, including some subtropical ones. The majority of the tropical and subtropical species are treated separately, since the author's contribution here consists mainly in a critical study of W. A. Murrill's type specimens. The text is accompanied by numerous microscopical drawings (56 figures) and original photographs of the fresh fruiting bodies (on 98 plates). There are 232 complete descriptions (including data on the iodine reactions of the spores and tissue, in addition to all macro- and microscopical details), and the synonymy is given with care and responsibility.

At the present stage of our knowledge of the Basidiomycetes, it is essential that taxonomic monographs based on a broad approach (not excluding cytology, anatomy, chemical characters, and ecology) should continue to be published. This statement, self-evident as it may appear, is not one taken for granted by all botanists, and it is difficult to find a publisher for the larger monographs. Under these circumstances, mycologists will gladly join the author in expressing his appreciation to the University of Michigan Press for accepting the manuscript. It is a regrettable fact that in the taxonomic field many papers with a narrow,

schematic concept of systematics, full of deficiencies, and with few actual contributions to our knowledge have found their way into the literature, and it has become very difficult for the biologist who is looking for the best information currently available to differentiate between really modern and merely recent monographs. It is a pleasure to acknowledge that A. H. Smith's *Mycena* book belongs in the category of important contributions, with an immense number of new descriptive data, and a key that will satisfy those who have the experience and discrimination to use scientific keys to the Basidiomycetes.

It has been said, in a review of an earlier *Mycena* monograph by the French mycologist R. Kühner, that it is becoming increasingly more difficult, and even impossible, for a non-specialist to use modern taxonomic papers on agarics because of the new anatomical and chemical characters introduced by Kühner. Maybe with this statement in mind, A. H. Smith has endeavored to exclude the Melzer reaction both from keys and from his main classification. It is debatable whether or not this procedure should be considered an improvement. The reviewer is inclined to think that it is not. There is also the perpetual matter of nomenclature. The reviewer would have preferred some new names instead of older European names with uncertain interpretation. But the author has conscientiously followed the International Rules of Nomenclature, which will make the names he has adopted more stable than those adopted in other papers—altogether too numerous—where the authors seem to make their own rules.

ROLF SINGER



THE FERNS OF NEW JERSEY Including the Fern Allies.

By M. A. Chrysler and J. L. Edwards. Rutgers University Press, New Brunswick. \$4.00. x + 201 pp.; text ill. 1947.

An excellent descriptive manual of the ferns and fern allies of New Jersey, finely printed and illustrated. There are introductory chapters on the structure and life history of a typical fern plant, on distributional phenomena, classification and nomenclature, and on the problem of fern hybrids. The book is amply supplied with keys and photographs by which most of the species can be identified. Spot maps of known distribution in the state are given for nearly all of them. The authors have been conservative in their treatment of species complexes, and have included only enough synonymy to make the book referable to the standard manuals. The descriptions and accompanying notes are brief, but are done in such a manner as to make the book usable for student and layman alike. The catalogue and its attendant notes appear to have been based upon ample collections and authoritative deter-

minations. Glossary, references, and an index close the book.

H. M. RAUP



FLORA OF DELAWARE AND THE EASTERN SHORE. *An Annotated List of the Ferns and Flowering Plants of the Peninsula of Delaware, Maryland and Virginia.*

By Robert R. Tatnall. *The Society of Natural History of Delaware, Wilmington.* \$3.50. xxvi + 313 pp. + 9 plates; text ill. 1946.

The Peninsula "Delmarva," comprising the State of Delaware, nine counties of Maryland, and two of Virginia, and forming the eastern shore line of the Chesapeake Bay, is, by virtue of its geologic structure, an area rich in botanical diversity. Made up of Coastal Plain and Piedmont Plateau, the former geologically young and the latter very old, the Peninsula has two very characteristic flora, while sharing in common a more mobile and less ecologically restricted flora. It is likewise an area where many plants end their northern or southern distribution. Tatnall, direct descendant of Edward Tatnall, whose *Tatnall Catalogue* of 1860 was one of the earliest botanical publications concerned with this region, has presented in this volume an annotated list of the ferns and flowering plants of the "Delmarva" peninsula, with the listing sequences generally constructed on the plan of Gray's *Manual*. Each species is given its scientific name according to the International Rules, a common name, origin if introduced, ecological habitat, and approximate flowering time. It should be a welcome book to students of our eastern flora.

C. P. SWANSON



À LA DÉCOUVERTE DES ORCHIDÉES DE FRANCE. *Les Livres de Nature.*

By J. Poucel; preface by Jean Giono. Editions Stock, Paris. 30 fr. (paper). 222 pp.; ill. 1942.

This little book, one of a popular series (*Les Livres de Nature*) is divided into two parts. Part I, "What Orchids Tell," has such subtitles as *The Mountain in Bloom*, *Aerial Cousins of the Tropics*, *the Strange Love-life of Orchids*, *the Fungus Eaters* or *the Mysteries of Germination*, *Underground Existences*, *Conjurers and Magicians*, *Chance and the Orchid-fancier* (by Jacques Delamain), *Where the Orchids Lodge* and in what *Companionship* (by P. LeBrun). This section attempts in a very popular way to indicate the scope of the Orchid Family, i.e., their variety and range, together with a comparison of the more showy tropical species with native species, a discounting of the generally credited theory of floral modifications for purposes of attracting

the fertilizing insects, the various methods of pollination based on the work of Darwin, the phenomena of mycorrhizal penetration into orchid roots as noted by Bernard, the various root structures, the supposed magical properties of orchids, the discovery of natural hybrids, the writer's experiences with other orchid hunters, and the soil preferences of different species.

Part II, entitled "How I Gathered Our 76 Indigenous Species," has the following sections: On the Chase—the Pursuit and Capture of Orchids, including a botanical apprenticeship with the common species; Herborizing and the Rarer Species; and Life in the Open and the Observing of Nature. After rationalizing orchid-hunting and explaining its advantages, the author gives his own experiences while collecting both the common and rare species.

At the end of the book there is a List of the Orchids of France (occupying 6 pages) giving, in tabular form, each species name with its translated meaning, preferred habitat, time of blooming (month), and relative abundance or rarity. Some of the figures (line drawings) are clear and definite, but most of the photographs are poorly reproduced and very faint.

Altogether this little book is a readable and entertaining introduction to the subject of the native orchids of France, and contains much valuable information, especially in the tabular list at the end.

CHARLES SCHWEINFURTH



A TAXONOMIC STUDY ON THE GRASSES OF PENNSYLVANIA. *The American Midland Naturalist*, Volume 38, Number 3.

By Richard Walter Pohl. *The University Press, Notre Dame, Ind.* 90 cents (paper). Pp. 513-604; ill. 1947.

There are 77 genera, 233 species, and 40 varieties and named forms of grasses recorded from Pennsylvania. The diversity of the grass flora is shown by the fact that, except for two small tribes (one of a single introduced species), all tribes known from the United States are represented. Two of the climatic zones of Livingston, medium and cool, occur in the state. The grasses of Pennsylvania are first grouped by range and habitat, those of wide distribution in the state, those of northern range, of southern range, of Atlantic Coastal Plain, of river valleys, of aquatic or wet ground, and of serpentine barrens and limestone soils. Introduced species, 73 in all, including 8 from other states, mostly western, are listed. Ballast waifs and the like, collected but once or twice and apparently extinct within the state, are listed under Excluded Species. Most of the work is devoted to the Systematic Catalogue of the Grasses of Pennsylvania. This is provided with carefully worked-out keys to tribes, genera, species, varieties, and

forms. References to recent revisions and articles are given under the genera. The species and varieties are not described, the ample keys serving to identify them, but detailed habitats and localities are given, and specimens are cited for critical species. What makes the catalogue of especial value is the fact that all records are based on specimens examined by the author in the herbarium of the University of Pennsylvania and in other large herbaria, and not on unverified reports.

AGNES CHASE



THE REDWOODS OF COAST AND SIERRA. *Fourth Edition.* By James Clifford Shirley. *University of California Press, Berkeley and Los Angeles.* \$2.00 (cloth); \$1.00 (paper). 84 pp. + 1 plate; text ill. 1947.

This little book was first published in 1936 as a popular account of the redwood forests of California. The current edition is the fourth. It is informative, well written, and well illustrated with full-page photographs. There are maps of the modern and fossil distributions of the redwoods. The book contains chapters on the discovery of the redwoods by Europeans, on their distribution, vitality, manner of reproduction, size, age, and uses. Finally, there is an eloquent plea for the preservation of stands that will adequately represent the species. A partial bibliography is included for those who wish to delve more deeply in the lore of the "Big Trees."

H. M. RAUP



THE CULTIVATED SPECIES OF PRIMULA.

By Walter C. Blasdale. *University of California Press, Berkeley and Los Angeles.* \$7.50. xii + 284 pp.; ill. 1948.

This work supplies still another authoritative monograph on genera of horticultural interest—this time on *Primula*. The first chapter is concerned with a definition of terms, the history of the genus and its classification. Another chapter deals with biological characteristics such as the life cycle, teratological peculiarities, dimorphism, hybridization, geographical distribution, and phylogeny. Under Horticultural Requirements and Methods, the author discusses propagation, soil and moisture requirements, diseases and pests. The next fifteen chapters are devoted to a detailed account of the 34 sections of the genus *Primula*, with observations concerning all the species of known or potential value for cultivation. Hints are given regarding the successful cultivation of various species, based on the author's own experience. A final chapter on the cultivation of *Primulas* in the United States emphasizes the neglect of the group in this country, save for the Pacific

Northwest. The book is illustrated with figures, a map, and 88 photographs nearly all taken by the author. A bibliography is appended.

ALBERT F. HILL



BULBS FOR BEAUTY.

By Charles H. Mueller; drawings by Else Bostelmann. M. Barrows and Company, New York. \$3.50. 296 pp. + 16 plates; text ill. 1947.

Bulbs for Beauty was written by its author, a professional grower and dealer in bulbs, with a three-fold purpose: (1) to attempt to answer the many questions which daily arise to vex the amateur by providing useful information; (2) to enable the gardener to obtain better flowering results by discussing proper culture methods; and (3) to suggest ways for obtaining greater enjoyment from bulbs by furnishing descriptions of varieties and methods of planting. Throughout the work, ease of culture and market availability are cardinal principles.

The first eight chapters deal with matters of general interest, as evidenced by the titles: This World of Bulbs; Matters Botanical; Giving New Bulbs a Start; Spring Care That Looks Ahead; The Question—To Lift or To Leave; How Deep to Plant; The Weather Plays a Part; Bulb Enemies Outwitted. Considerable space is devoted to specific bulbs—to tulips in particular. In addition to general information, some 170 varieties are characterized briefly. Daffodils and narcissus, hyacinths, lilies, and iris each have one or more chapters devoted to them. Twenty-five other bulbs of lesser importance are discussed in the chapters entitled Early and Irrepressible, and Satellites for Spring Stars. Other chapters are concerned with such matters as Spring Planting for Summer Bloom (chiefly dahlias and cannas); More Color in Summer (featuring 13 different species); Hardy Bulbs with Autumn Flowers (colchicum and autumn crocuses); Easy Indoor Flowering; Woodland Planting; and Bulbs for Rock Gardens and White Gardens. The last two chapters are supplemented by lists of hardy species.

The book concludes with a month by month reminder, a glossary and an index. It is illustrated with fifteen fine photographs and numerous line drawings by Else Bostelmann.

ALBERT F. HILL



ROSES OF THE WORLD IN COLOR. *Third Edition.*

By J. Horace McFarland. Houghton Mifflin Company, Boston. \$5.00. xxiv + 296 pp.; ill. 1947.

No flower is more universally loved than the rose, and probably no one person is better qualified to discuss technically and appreciatively the merits of roses and

rose culture than is J. Horace McFarland. In the third edition of this book the more recent introductions, arranged alphabetically, are included and fully described, together with information on their introduction, thus swelling the total list of varieties and species described to nearly six hundred. The number of colored illustrations numbers well over one hundred, giving the rose enthusiast a bewildering array of colors, sizes, and shapes from which to choose. However, this is a book for a select group of gardeners; its usefulness is limited, and could well have been extended by the inclusion of selected lists of varieties for various cultural and climatic conditions. The uninitiated grower will have difficulty in choosing his roses from the colored plates, all of which are lavishly beautiful; for the text, while interesting, is not informative.

C. P. SWANSON



BEGONIAS FOR AMERICAN HOMES AND GARDENS.

By Helen K. Krauss; Line Drawings by Marjorie-Ann Tobin, Begonia Charts by Alpha H. Gere. The Macmillan Company, New York. \$4.00. xxvi + 228 pp. + 24 plates; text ill. 1947.

Probably no genus of ornamental plants equals the tremendous diversity of leaf structure and plant habit exhibited by the begonias. The number of cultivated varieties seems endless. Helen Krauss considers the genus to be made up of over 1,200 good species, but the ease with which these may be hybridized leads one to suspect that a horticultural species and a taxonomic species are not one and the same. Be that as it may, the begonias have become one of our favorite household plants, and the author has performed a Herculean task in attempting to bring order out of the chaos of synonymy in begonia nomenclature. To what extent she has succeeded can only be determined by a specialist. She has, however, presented a useful series of genealogical charts that trace the history of the many varieties; and these, together with a brief sketch of the discovery and introduction of the American and Asiatic species, provide the flower lover with a most interesting bit of botanical lore. Each of the major types of begonias has a chapter devoted to it. An excellent chapter on methods of culture and propagation, followed by a reference list, makes this a commendable volume for both the amateur and the professional gardener, even though its value to the systematist is questionable.

C. P. SWANSON



OUR OLD-FASHIONED FLOWERS.

By Olive Percival. Pasadena Humane Society, Pasadena; The Ward Ritchie Press, Los Angeles. \$5.00. viii + 245 pp.; ill. 1947.

Attractively bound, and prefaced by a syrupy, sentimental discourse on flower-name history, Olive Percival's volume is a compilation of "Old-fashioned Flowers—a Latin-English list," "Old-fashioned roses—an English-Latin list," and "Pot herbs, sallet herbs, strewing herbs, and simples—a Latin-English list," each alphabetically arranged. These are followed by an excellent bibliography of source references, and two English-Latin indices of flowers and herbs, alphabetically listed according to English name. The lists make fascinating reading, and it is to be regretted that many of the names have disappeared with the passage of time. Such names as "Meet-her-in-the-entry-kiss-her-in-the-buttery" (*Viola tricolor*), "Devil's Guts" (*Cuscuta*), "Maiden's Ruin" (*Artemisia abrotanum*), and "Sorcerer's Violets" (*Vinca*) might well have been preserved. Certainly our forefathers were not lacking in imagination.

C. P. SWANSON



TREES AND TOADSTOOLS.

By M. C. Rayner. Rodale Press, Emmaus, Pennsylvania. \$2.50. x + 91 pp. + 18 plates; text ill. 1947.

This is an American printing, unchanged, of the authoritative but non-technical little book reviewed in Q. R. B. 21: 84, 1946. It is a very worth-while addition to any biological library, institutional or personal.



ECONOMIC BOTANY

HORMONES AND HORTICULTURE. *The Use of Special Chemicals in the Control of Plant Growth.*

By George S. Avery, Jr. and Elizabeth Bindloss Johnson; with the collaboration of Ruth M. Addoms and Betty F. Thomson. McGraw-Hill Book Company, New York and London. \$4.50. xii + 326 pp.; ill. 1947.

Whenever a new field of investigation claims the attention of scientists it is often many years before the results of their investigations find their way into textbooks. Only the specialist who has access to the widely scattered information on the subject can accurately evaluate the results. *Hormones and Horticulture* thus renders a great service to botanists and horticulturists by bringing together the important data regarding the use of chemicals involving hormones in the control of plant growth, an advance which the authors regard as a "real chemical revolution in agricultural practice." Throughout the book the word "hormone" is used as synonymous with "auxin" or "growth substance."

The main facts of historical importance in the field are outlined, and the results obtained by the many workers are recorded. Specific directions are given for

applying the chemicals, their usefulness in horticultural practice is evaluated, and the trends in the field are pointed out. The senior author, a leader in hormone research, has had the critical advice of many horticultural specialists in the preparation of the book, the scope of which is best indicated by the titles of the chapters: Hormones and the Rooting of Cuttings; Blossom-thinning Sprays in the Control of Fruit Production; Hormone Control of the Preharvest Drop of Fruits; Hormones as Aids to Fruit Set and to Seedless Fruit Production; Hormone Treatment of Seeds; Hormones and Vitamins in Relation to Miscellaneous Growth Phenomena; Hormones and Weed Control; Breaking Dormancy with Chemicals; Hormones in Prolonging or Inducing Dormancy; Chemical Production of New Varieties [dealing with the use of colchicine and other chemicals in the production of polyploidy]. Extensive bibliographic references and a subject index are included.

ALBERT F. HILL



GROWTH REGULATORS for Garden, Field, and Orchard.

By John W. Mitchell and Paul C. Marth. The University of Chicago Press, Chicago. \$2.50. viii + 129 pp. + 1 plate; text ill. 1947.

The increasing practical importance of the natural and synthetic plant growth regulators makes it imperative that simplified instructions be issued for the application of these chemicals, if full use is to be made of them in the many and diverse fields of agriculture. Improperly handled, these chemicals are apt to be dangerous tools in the hands of the uninformed, and since the amounts required are so minute as compared to, say, spray or fertilizer applications, the damage to plants by uncontrolled dosages can be extensive. Mitchell and Marth, two of the investigators who have been responsible for furthering this field of research, have presented easily-followed methods for the use of plant growth regulators as weed-killers, rooting compounds, fruit-drop preventatives, yield and quality promoters, and inducers of other plant responses. The value of the synthetic growth regulators to the commercial grower is so great that no producer of crops should be without knowledge of the methods of application contained within this slender volume. The home owner, too, will find that his tasks will be enormously simplified by a judicious use of these truly remarkable compounds.

C. P. SWANSON



CROISSANCE DES VEGETAUX CULTIVÉS. Principes d'Agronomie—Tome II. Third edition.

By Albert Demolon. Dunod, Paris. 580 fr. (paper). xiv + 367 pp. + 2 plates; ill. 1946.

This book, the second volume of *The Principles of Agronomy*, is in reality a textbook of plant physiology with agricultural applications. Published first in 1934, this new edition brings the subject matter up to date, with the inclusion of much new material. The first part of the work is devoted to the physical factors which influence growth, i.e., light, temperature, etc. The second section, concerned with chemical factors, has chapters on the atmosphere and plants; the root system; water; mineral nutrients; nitrogen; phosphorus and sulphur; potassium; calcium, magnesium, and other mineral elements; and the phenomenon of toxicity in agriculture. A third section deals with biological factors, chiefly microorganisms; and the fourth part discusses growth and yield under such headings as the laws governing plant growth, fertilizers, the quality of the harvest, experiments in agronomy, and the analysis of the plants.

ALBERT F. HILL



SEMENCES ET PREMIÈRES PHASES DU DÉVELOPPEMENT DES PLANTES. *Caractéristiques de la Provenance des Céréales. Extrait des Annales de Phylogénétique (Tome VII, numéro spécial—1941).*

By Louis François. Imprimerie Nationale, Paris. 55 fr. (paper). 90 pp.; ill. 1941.

Weeds are of so much economic importance to the farmer and gardener that any addition to the literature of the subject is welcome, particularly when it pertains to the identification of the seeds or seedling stages of weeds. In the present paper, which follows the style of the author's previous works on the same general subject, two different types of weed seeds are considered: (1) the seeds of plants which occur with cereals, and (2) the seeds of species which are found with forage legumes and grasses. In the latter instance, one section is devoted to the weeds whose seeds are usually found mixed with those of the cultivated plant; and a second section is concerned with species which play an important role during the actual cultivation of the crop.

The most frequently encountered species in 25 different families are discussed. Full descriptions of the seed (or fruit) and of the seedlings are given, often with keys. Where essential, the characteristics of the mature plant are also given. The scientific and common names are furnished, along with data regarding the geographic distribution (often with maps). Perhaps the most valuable feature of the paper is the large number of excellent photographs of the individual seeds and fruits. The reproductions of the seedlings are not as well done.

ALBERT F. HILL

ARMCHAIR GARDENING. *Some of the Spirit, Philosophy, and Psychology of the Art of Gardening.*

By Thomas Hubbard McHatton. The University of Georgia Press, Athens. \$2.50. viii + 130 pp. 1947. Garden books are so numerous and so varied that the everyday lover of plants is likely to become bewildered and perhaps a little weary of the mass of data which is to be found on every side, ready for his perusal. Most of the available books follow a regular pattern and are either pictorial (and often expensive) or cyclopedic (and by the same token a bit boring). What a relief it is to find a book written in a philosophical vein and emphasizing the psychology of the art of gardening, with stress laid on how to appreciate a garden through the utilization of all the senses, rather than the more prosaic business of how to grow plants.

As the author, who is Professor of Horticulture at the University of Georgia, says: "It is through the reactions of the human being to things that can be seen and heard, smelled, tasted, and touched, that he finds the enjoyment and pleasure, or the distaste, that may be had from the work of a garden artist."

McHatton's thesis is that gardening is as much one of the fine arts as sculpture, painting, architecture, or music, and equally appealing to the senses. With amazing clarity and in non-technical terms he shows what part sight, hearing, smell, touch, and taste each plays in the appreciation of a garden. He points out that the good gardener must have a real interest in the plants themselves.

The final chapters are more historical in nature and deal with the genesis of American gardening, America's role in gardening, and "Garden Treks"—tours to famous gardens.

ALBERT F. HILL



NEW RICHES FROM THE SOIL. *The Progress of Chemistry.*

By Wheeler McMillen. D. Van Nostrand Company, New York. \$3.50. xii + 397 pp. 1946.

The story of the industrial utilization of plant raw materials is always fascinating. Chemurgical research in recent years has found many new uses for farm crops and farm wastes, and has developed new crops for man's greater benefit—all pointing to a new industrial and economic security with an underlying philosophy of creating wealth and opportunity for all.

Wheeler McMillen, the author of this volume, is one of the world's most famous agricultural editors and, as president of the National Farm Chemurgic Council, Inc., has seen his dream of bringing agriculture, industry and science into countless profitable relationships come true. The book attempts: (1) to report practical chemurgic developments; (2) to outline the history of the

chemurgic concept and of its organization; and (3) to state the significance and implications of the underlying philosophy.

The subject matter may best be indicated by a listing of the table of contents: The Background; How Chemurgy Started; Chemurgy Is Organized; The Cigarette Paper Story; Corn, a Crop with New Ideas; Corn cobs and Oat Hulls; Soybeans, a New Crop that Has Arrived; New Crops for Wheat and Cotton Lands; A Farmer Works at Chemurgy [the growing of cotton to precise industrial specifications]; Chemurgy in the Everglades [chiefly lemongrass oil and sweet potato starch]; Oils from the Sun; Many a Mickle Makes a Muckle [discussions of sage, coriander, castor beans, bamboo, insecticides, guar, milkweed, etc.]; The Empire of Fibers; Wealth from the Woods; Animal Chemurgy; Fruits from New Branches; The Subject of Alcohol; American Farm Rubber [guayule and Russian dandelion]; Government Takes a Hand; Chemurgy Reaches the Grassroots; How the Chemurgic Council Works; What Makes It Pay?; The Economics of Chemurgy; and A Force for Peace.

The book is well written and should prove interesting and enlightening to everyone, whether professional or amateur, who is interested in agriculture, economics, or the general welfare of the nation.

ALBERT F. HILL



DANISH AGRICULTURE: Its Economic Development. A Description and Economic Analysis Centering on the Free Trade Epoch, 1870-1930.

By Einar Jensen. J. H. Schultz, Copenhagen. Dan. Kr. 17.—. xvi + 417 pp. + 1 map + 2 charts; text ill. 1937.

This book, as the subtitle implies, is an interpreted economic history and description of Danish agriculture. The early history of Denmark is surveyed in Chapter I. This is followed in subsequent chapters by descriptions of the climate, soil topography, people, institutions, land policies, commercial policies, agricultural practices, and agricultural statistics. Four chapters are devoted to economic phases of Danish agriculture and one to cooperative agricultural organizations. From the system of peasantry common to other European countries, Denmark has evolved a system of prosperous free business farms, with the farmers owning and operating the agencies that process and market their products on a cooperative basis. The grain and sheep farms that prevailed before 1870 were transformed into the more intensive enterprises of dairying, and hog and poultry production. Industries attracted labor from the rural regions. The combined effect was to permit a stable farm population and to avoid the subdivision of farm lands into uneconomic units. Cooperative stores sup-

plied the farmers with most of their needs. Extensive exports of butter, eggs, and bacon facilitated the importation of feed grains.

Acre yields of grain were increased fully 50 per cent between 1875 and 1925 by improved farming methods, including better crop rotations, the use of manures and fertilizers, and the breeding of better varieties. This was accompanied by comparable improvements in livestock production. Mechanization replaced much of the hand labor.

The author has presented a detailed analysis of how the free Danish people were able to develop a high type of agriculture that has stood as a model to other nations for half a century.

JOHN H. MARTIN



NATURE AND PREVENTION OF PLANT DISEASES. Second Edition. Blakiston Books on Agriculture.

By K. Starr Chester. The Blakiston Company, Philadelphia and Toronto. \$5.00. xii + 525 pp.; text ill. 1947.

In this second edition of the book first published in 1942 (see Q. R. B. 18: 87), the subject matter is rearranged and brought up to date, additional diseases are included, and some 30 illustrations and numerous references have been added. The book, which is designed as a textbook for students taking only a single course in plant pathology, appears to meet these requirements to a marked degree. Although considerable attention is given to general fundamental principles, procedures, and techniques of plant pathology, the book also serves as a handbook for the recognition and control of the more important plant diseases. Obviously this arrangement results in some duplication of subject matter. In addition to parasitic diseases caused by fungi, bacteria, viruses, nematodes, and algae, the author discusses parasitic seed plants, mineral-deficiency symptoms, and diseases due to other unfavorable environmental conditions.

The discussions of specific diseases are grouped according to the causal organism or condition. The well illustrated text is divided into 20 chapters followed by a comprehensive glossary. The normally highly technical subject matter is covered in a simple readable style calculated to maintain the interest of the beginning student in plant pathology. Unfamiliar terms are defined, and structures are illustrated by simple drawings.

The obvious inaccuracies and ambiguities so frequent in the first edition have been corrected. However, a number of inaccuracies appear even in the second edition. For example, Kanred wheat was selected in 1906 from a Russian wheat introduced several years previous to 1906 (p. 31). Austin wheat is not *quite* resistant to leaf rust, since it suffered heavily in 1947 (p. 37).

Stripe rust has been known in the United States only since 1915, although it is now known to have been in the country since 1892 (p. 38). The author mentions only the less prevalent "dwarf bunt" form of *Tilletia caries*. The life history and extensive research on the common form and the numerous resistant varieties that have been developed have been completely overlooked (pp. 52, 57). Head smut of sorghum is considered to be "too rare to warrant special efforts at control" despite its common occurrence in Minnesota for many years (p. 59). Yellow berry of wheat, which is listed as a disease, is merely the result of starch deposition in excess of a supply of protein sufficient to form a cornaceous matrix in the endosperm. Also yellow berry wheat is erroneously stated to be "low in test weight" (p. 369). The author falls into the common error of confusing soil alkalinity with soil salinity (p. 377).

Chester's book is the most readable text on plant pathology the reviewer has encountered. The forthright style, however, often fails to allow for necessary qualifications and exceptions to the general rule.

JOHN H. MARTIN



THE NATURE AND PREVENTION OF THE CEREAL RUSTS AS EXEMPLIFIED IN THE LEAF RUST OF WHEAT. *Annales Cryptogamici et Phytopathologici (incorporating Annales Bryologici)*, Volume IV.

By K. Starr Chester. *Chronica Botanica Company, Waltham, Massachusetts; Stechert-Hafner, New York.* \$5.00. xvi + 269 pp.; ill. 1946.

This monograph reviews and interprets the literature on the cereal rusts from early times up to the present. A valuable feature is the review of contributions in more than 50 papers published in the Russian language, which the author himself had previously translated. The book is greatly strengthened and amplified by inclusion of the author's views, along with contributions from the literature on cereal rusts. As the title indicates, the different cereal rusts are discussed, but with major emphasis on the leaf rust of wheat, which has been the chief subject of the author's own rust investigations.

The book consists of 15 chapters and an extensive bibliography. It covers the history, origin, distribution, and economic importance of the rusts, the effect of rust on the host plant and its yields, susceptible hosts of cereal rusts, and the symptomatology and etiology of the rust diseases in the first six chapters. Two chapters are devoted to physiologic specialization, two others to factors affecting rust survival and development, and one chapter to rust dissemination, annual cycles, and epiphytotic. The last four chapters discuss the control of rusts by natural, regulatory, and cultural methods, by the use of fungicides, and by rust resistance.

The important contributions of the author are a

critical analysis of the factors involved in the dissemination, disease attacks, and control of the rusts, and the evaluation of differential host varieties for determining physiologic races of the rust organisms. The book is a valuable contribution to the knowledge of cereal rusts. It is unfortunate that it could not have been enlarged to cover the stem rusts of cereals and their alternate host plants more completely.

JOHN H. MARTIN



PFLANZLICHE INFektionsLEHRE. *Lehrbuch der Allgemeinen Pflanzenpathologie für Biologen, Landwirte, Förster und Pflanzenzüchter. Lehrbücher und Monographien aus dem Gebiete der exakten Wissenschaften, 3. Reihe der experimentellen Biologie, Band I.*

By Ernst Gäumann. Verlag Birkhäuser, Basel. S.Fr. 48.50 (cloth); S.Fr. 44.50 (paper). 611 pp.; ill. 1946.

Though described by the author as a textbook of general pathology for biologists, agriculturists, foresters, and plant breeders, this book is virtually a monograph on the biology of plant disease. Unlike most textbooks in this field, it gives no detailed discussions of individual plant diseases, but rather a comprehensive delineation of the biological principles that apply to plant diseases generally. The author's international viewpoint and wide grasp of the world literature have enriched the text with a wealth of pertinent examples selected from an appended bibliography of 660 titles.

The material is divided into chapters dealing with the nature and ecology of infection, the parasitic properties of pathogens, the predisposition and disease reactions of host plants and their modification by the environment, and the course and manifestations of disease, with fewer than six pages devoted to disease control.

As in the author's earlier *Biologie der Pflanzenbewohnenden parasitischen Pilze* (with E. Fischer, 1929), which this book somewhat resembles, particular emphasis has been laid on the dynamic defensive reactions of plants, and the hundred pages devoted to this important and often neglected phase of plant disease biology represents a particularly valuable contribution.

Many plant pathologists are apprehensive or dismayed at seeing their science becoming more and more an *Anhang* to crop production. The reason is that they have neglected the fundamental biological principles of their science in efforts to cater to the ad hoc considerations of agriculture. Gäumann's book should prove to be both an inspiration and a valuable aid to those teachers whose desire is to preserve and develop an autonomous science of plant pathology, as well as a useful reference work for any biologist whose horizon of professional interest includes parasitism in plants.

K. STARR CHESTER

DISEASES OF FIELD CROPS. McGraw-Hill Publications in the Agricultural Sciences.

By James G. Dickson. McGraw-Hill Book Company, New York and London. \$4.50. xii + 429 pp.; ill. 1947.

This book is an up-to-date expansion of class outlines that had previously been processed and distributed by the Burgess Publishing Company, Minneapolis. It covers the diseases of most of the field crops of the United States. The diseases of other field crops, such as sugar beets, field peas, field beans, and potatoes, were deferred for inclusion in a book on diseases of vegetable crops, by J. C. Walker, to be published in the same McGraw-Hill series of publications in the agricultural sciences.

Section I of the book consists of the Introduction and a chapter on the Physiological Anatomy of Plant Groups in Relation to Disease. In Section II are 10 chapters devoted to the diseases of the different grains and grasses. Section III consists of three chapters covering the diseases of alfalfa, sweetclover, clover, and soybeans. Section IV consists of three chapters describing the diseases of cotton, flax, and tobacco. The appendix includes two running tables that list the various field crop diseases according to the causal factor or causal organism of each. Each chapter is followed by an extensive list of references.

The book will serve as a convenient reference on the diseases of the crops that are included, but many of these diseases are discussed much too briefly for complete coverage. A further expansion of the subject matter would be very helpful to the casual reader. A more critical reading and proof-reading would have eliminated the frequent misspellings, incorrect initials of authors, and other minor errors, e.g., Jensen, a Dane, is listed as being in Sweden. The most serious oversight was the failure to correct the indicated magnification of the illustrations of spores that were reduced for reproduction. This is unfortunate since spore size is an important character for identification. *Diseases of Field Crops* is a very useful and valuable contribution to the literature of the subject.

JOHN H. MARTIN



ALCALOÏDES ET PLANTES ALCALOÏFÈRES. "Que Sais-Je?" Le Point des Connaissances Actuelles.

By F. Moreau. Presses Universitaires de France, Paris. 75 fr. (paper). 128 pp.; ill. 1946.

This volume, one of the series of popular French handbooks of knowledge known as "Que sais-je?", deals with alkaloids and alkaloid-bearing plants. Part I comprises a general discussion and treats such topics as the general nature of alkaloids, their biological role, physical and chemical properties, chemical classification, and physiological characteristics, together with a list of alkaloid-bearing plants arranged by families.

Part II is devoted to short monographs of the more important species which contain alkaloids. A description of each plant, its distribution, and the nature, history, general properties, and therapeutic uses of the specific alkaloids are considered. The plants discussed include aconite; the opium poppy; tobacco; the mydriatic Solanaceae (*Atropa*, *Hyoscyamus*, and *Stramonium*); quinine; the caffeine-plants (coffee, tea, maté, cacao, kola, guarana); colchicum; coca; *Conium*; the arrow and ordeal poisons, *Physostigma venenosum*, *Strychnos nuxvomica*, *S. ignati* and *S. toxicaria* (curare); ergot; and *Amanita muscaria* and the other mushrooms which contain muscarine and myco-atropine. Most of the species are illustrated by line drawings.

ALBERT F. HILL



LONG VEGETABLE FIBERS: Manila, Sisal, Jute, Flax, and Related Fibers of Commerce.

By Ludwig Weindling. Columbia University Press, New York. \$5.00. xx + 311 pp. + 3 plates. 1947.

This monographic study of the long vegetable fiber industry fills a great gap in our available information regarding economic plants. Plant fibers, other than cotton and wood, have been much neglected in the past, and the only comprehensive works have been of foreign origin.

The present book, written by an engineer with firsthand knowledge of the field, attempts to marshal all the pertinent facts regarding the industry in all parts of the world, but with special emphasis on the American scene. The author's purpose, stimulated by the advent of the Second World War, is to present the commercial aspects of the industry in order to furnish a statistical background for national planning, and to bring together in one place the essential technical information and industrial statistics regarding fibers.

He includes such topics as the importance of the industry in peace-time and in war; the present and possible future sources of raw materials; the mechanism for distribution; the nature and amount of imports; and various specialized economic aspects, such as the amount of capital investment, the number of employees and their wage scales, and the quantity and value of the output.

The first three chapters are introductory in nature and deal with the uses and development of vegetable fibers, their characteristics and the general economic aspects of the industry. Seven chapters are devoted to the hard fibers, used chiefly for cordage and binder twine; and another seven to the soft fibers utilized in the manufacture of textiles. In each case the physical and chemical characteristics of the fiber are given, as well as the methods of cultivation, harvesting, decortication, data regarding commerce, grades, qualities, statistics as to acreage, output and international trade,

and a discussion of the manufacturing industry in some detail.

The hard fibers included are manila hemp, sisal, istle, New Zealand hemp and Mauritius hemp, with chapters on cordage and other hard fiber manufactures and the cordage industry in the United States and Canada. The soft fibers described are jute, with chapters on jute manufacturing and the jute industry; flax, with an account of the linen industry and linen manufacturing; hemp; sunn hemp and ramie.

Well expressed and interestingly written, with some fifty tables and an adequate index, the book should appeal not only to readers who are specialists in economic planning, in general commerce, or in the textile industry, but to anyone interested in useful plants as well.

ALBERT F. HILL



FOREST VALUATION, *With Special Emphasis on Basic Economic Principles. The American Forestry Series.*

By Herman H. Chapman and Walter H. Meyer. McGraw-Hill Book Company, New York and London. \$6.00. xii + 521 pp. 1947.

This textbook, designed primarily for use in courses in forest economics, management, or finance, is the successor of *Forest Valuation* (1925), and *Forest Finance* (1935). It presents a modern treatment of these fields and is especially noteworthy for its emphasis on the application of ordinary basic economic principles to forest valuation. These fundamental economic laws are outlined in the six introductory chapters. The basis of all the economic discussions in the book is the idea of a competitive economy founded on private initiative and free markets. The importance and economic role of public ownership and operation, however, is given proper consideration.

The book covers a wide field and is up to date in its approach. Discount (the key to all sound appraisals of value) is stressed throughout, along with detailed analyses of grade composition and value of standing timber. By emphasizing the fundamental laws of economics in their direct relation to all phases of forest economics and valuation, the authors make their subject more vital and bring out its importance both to professional foresters and to owners and operators of forest properties as well.

ALBERT F. HILL



SMALL-FRUIT CULTURE. *A Text for Instruction and Reference Work and a Guide for Field Practice. Second Edition.*

By James Sheldon Shoemaker. The Blakiston Company, Philadelphia and Toronto. \$4.00. viii + 433 pp.; ill. 1948.

The ready acceptance and desirability of frozen-packed foods, the availability of home freezers, and the feasibility of small-fruit culture even in suburban areas makes the second edition of this volume a particularly welcomed one. Although essentially a textbook, and thoroughly documented with references from original research papers, it is still a readable and useful book for the home owner whose space is limited but whose gardening urge is strong. Each of the fruits discussed is a commercially important one, and each is considered under the following topics: commercial importance, regional distribution, variety characteristics and preferences, yield versus cost, propagation methods, cultural practices, and marketing and storage procedures. Recent information on sprays, new varieties, frozen-pack preservation, and improved cultural practices, as well as new sections on the youngberry, the boysenberry, and the vinifera and muscadine grapes brings the book up to date. The book has much to recommend it to the small-fruit grower, whether commercial or amateur. It suffers, however, from very poor reproductions of the photographs.

C. P. SWANSON



TROPICAL AND SUBTROPICAL FRUITS. *Popular Series, Botany, Number 26.*

By B. E. Dahlgren; drawings by Albert Frey. Chicago Natural History Museum, Chicago. 50 cents (paper). xii + 72 pp. + 1 plate; text ill. 1947.

This little book, the most recent of the Popular Series of Botanical Publications issued by the Chicago Museum of Natural History, is devoted to the more important edible fruits of the tropics and subtropics. A brief historical introduction precedes the text, which deals with 28 fruits of Old World origin and 37 which are natives of the New World. The excellent illustrations, from pen and ink drawings made by Albert Frey, are supplemented by brief but adequate descriptions of the plant and pertinent facts regarding the fruit in question. The scientific names are accurate, and the vernacular names used in the American tropics are also given. The reader who wishes more detailed information will find available a bibliography of 27 titles. An index is appended. All in all this work should aid materially in acquainting the public with these increasingly important products of the tropics.

ALBERT F. HILL



VERZAMELDE RAPPORTEN VAN PROEVEN IN ZAKE HET BEWAREN EN HET KOELEN VAN UIEN 1940-1942. I. *Het bewaren van uien in een fruitbewaarplaats; II. Het bewaren en het koelen van uien; III. Het ascorbinezuurgehalte van bewaaruien. Mededeelingen en Overdrukken*

van het Instituut voor Onderzoek op het Gebied van Verwerking van Fruit en Groenten te Wageningen, Series I, Number 9, April, 1943.

(I) By T. Van Hiele, (II) by J. H. M. Van Stuijvenberg, (III) by H. J. Mathot. H. Veenman & Zonen, Wageningen. f. 1.- (paper). 56 pp. + 2 plates; text ill. 1943.



FACTOREN DIE DE VARIATIE VAN HET VITAMINE C IN DE PLANT BEPALEN. Mededelingen van het Instituut voor Onderzoek op het Gebied van Verwerking van Fruit en Groenten te Wageningen, Series I, Number 15, December, 1945.

By H. J. Mathot. H. Veenman & Zonen, Wageningen. f. 3.- (paper). ii + 176 pp.; ill. 1945.



HET VITAMINE-C-GEHALTE VAN VROEGE AARDAPPELEN, BEPALINGSMETHODE EN ORIËNTEEREND ONDERZOEK. Mededelingen en Oerdrucken van het Instituut voor Onderzoek op het Gebied van Verwerking van Fruit en Groenten te Wageningen, Series I, Number 10, May, 1943.

By H. J. Mathot. H. Veenman & Zonen, Wageningen. f. 0.50 (paper). 18 pp.; ill. 1943.



ONDERZOEKINGEN INZAKE DE TOEPASSING VAN CONSERVEERMIDDELEN BIJ DE BEWARING VAN AARDAPPELEN. Mededelingen van het Instituut voor Onderzoek op het Gebied van Verwerking van Fruit en Groenten te Wageningen, Series I, Number 16, July, 1946.

By T. Van Hiele, J. H. M. Van Stuijvenberg, and H. Veldstra. H. Veenman & Zonen, Wageningen. f. 6.50 (paper). iv + 176 pp. 1946.



GENERAL AND SYSTEMATIC ZOOLOGY

ZOOLOGY.

By Theodore D. A. Cockerell. Reese Publicity Company, Baltimore. \$1.00. xii + 558 pp. 1947.

T. D. A. Cockerell was the last survivor of that illustrious assemblage of naturalists of the Victorian era of which Charles Darwin was the most celebrated example. Cockerell never met Darwin personally, but he was well acquainted with Alfred Russel Wallace, who entrusted to him the preparation of the text for the revised edition of *Island Life*, and also recommended Cockerell to Francis Galton, when the latter was looking for someone to supervise the establishment of the Galton Laboratory at the University of London.

While yet a young man, Cockerell was threatened with tuberculosis and came to New Mexico for his

health. Finding the Mollusca, his special field of study, to be but sparsely represented in this environment, he turned his attention to bees, eventually becoming a great authority on them. When, at the close of the second world war, it was learned that the hasty evacuation of the British Museum had precipitated a hopeless shuffle of the labels on the African bees, this entire collection was sent to Cockerell at the Desert Museum at Palm Springs for rehabilitation, no other person being considered competent to accomplish this task.

The recent death of Cockerell makes a review of the reprinting of one of his best known works seem especially timely. Written originally for use in his own teaching in the University of Colorado, it became very popular in the schools of Great Britain, and when so many of that nation's school libraries were destroyed in the blitz the demand for a new printing arose. The current paper-bound edition was hurriedly printed to meet this demand. It consists of sixty-six fully independent chapters, which cover various aspects of zoological science—taxonomy, ecology, paleontology, genetics, zoogeography, to name a few, interspersed with brief biographical sketches of such figures as Darwin, Pasteur, Fabre, Agassiz, and others. In this way the book strongly emphasizes the cultural value of the study of zoology, and the inclusion of an original poem as the closing chapter bears witness to the fact that Cockerell was not only a scientist but a poet as well. This poem merits reprinting here but for its length. Instead, perhaps the reviewer will be pardoned for closing with another poem of Cockerell's:

To Posterity

You will see where we are blind.
We may seek but you will find.
Yet as you hold the golden thread
Passed on from days of long ago,
The names of those remembered
For what they strove to do and know
May still have power to stir the mind
And passing, leave a gift behind.



A FIELD GUIDE TO THE SHELLS OF OUR ATLANTIC COAST.

By Percy A. Morris. Houghton Mifflin Company, Boston. \$3.50. xviii + 190 pp. + 40 plates; text ill. 1947.

The title of this book is a misnomer. A field guide is a book which can be taken on field trips to enable the observer to identify his material as soon as he encounters it. Since it is obviously impossible for an observer to visit both the New England and Gulf coasts on the same trip, it is clear that this book attempts to cover too wide a geographic range to be a successful field

guide. The explanation doubtless lies in the fact that Roger Tory Peterson, who edited the series to which this book belongs, is a bird man, and many birds are migratory and cover vast ranges. But mollusks do not migrate, and each marine molluscan fauna is confined to an area within which the temperature is fairly constant. Thus the faunas from the two sides of Cape Cod differ fundamentally, and the same is true of Cape Hatteras and to a lesser degree of Cape Canaveral. The geographic range covered by a field guide to mollusks should therefore be bounded by capes which divert oceanic currents from the shore, causing discontinuity of temperature and demarking faunal limits.

Furthermore, when the scope of a field book is extended to cover several provinces it is obvious that no one of them can be accorded as careful attention as if the book were concentrated upon it alone. The present work does not include all the species which a casual observer might encounter on a visit to the shore—it is impossible that a book of its size could do so. A selection must be made, and, while it must be conceded that the author has used excellent judgment in selecting those species which are most likely to be met with, the possibility always remains that the observer may pick up something not noted in his guide book—a very disconcerting experience.

Again, the ornithologists seem to be able to get along quite well without using any subgeneric or sectional terms. How they can do this is one of the unsolved mysteries of science. While the omission of such nomenclatorial nuisances does simplify the taxonomy it is also likely to give the beginner a false sense of security as to the stability of nomenclature. When he later learns what great disagreement obtains among authorities as to the relative ranks of certain groups, and finds that the same species may be assigned to half a dozen nomenclatorial units by as many writers, he is likely to become disconcerted if not discouraged. The same holds true for the omission of authority citations; while the printed page does look cleaner and neater without them it must be remembered that the malacologist, whether he likes it or not, cannot confine his attention to shells alone, but must also consider such things as bibliographic references, synonyms, and homonyms, and that he is not immune to that perennial headache—the availability or unavailability of the names proposed by such writers as Martyn, Chemnitz, or Bolten. Whether or not polemic matters of this sort find a place in a field guide, it remains true that the authority citations should have been given; even though the reviewer cannot help feeling admiration for an author who has the fortitude to fly in the face of the International Commission on Zoological Nomenclature by omitting them altogether.

If the reader has by now gotten the idea that the reviewer disapproves of this work, it is unfortunate, for such is not really the case. Perhaps the trouble is that,

being a resident of the Pacific coast, he is unconsciously resentful of the fact that we have no Percy A. Morris in the west (where we need one badly); perhaps he is jealous of the many beautiful colored illustrations, which his own work lacks because his publisher felt that recourse to such would not be justified; or perhaps, having already written another review of this book (which was really quite enthusiastic), he has now gone stale.

A field book is always a necessary tool for the outdoor naturalist. The convenient pocket size of this book, the clarity of its illustrations, the scientific accuracy of its descriptions, its glossary of three pages and its index of seven, all serve to make it an excellent example of what a field book should be. It will be found especially helpful by the beginner.



INTRODUCTION À L'ENTOMOLOGIE. I. *Anatomie Generale et Classification. Nouvel Atlas d'Entomologie, Number 1.*

By R. Jeannel, with illustrations by Germaine Boca and Mme Bouisset. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 83 pp. + 10 plates; text ill. 1945.

INTRODUCTION À L'ENTOMOLOGIE. II. *Biologie. Nouvel Atlas d'Entomologie, Number 1.*

By R. Jeannel, with illustrations by Germaine Boca and Mme Bouisset. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 105 pp. + 10 plates; text ill. 1946.

INTRODUCTION À L'ENTOMOLOGIE. III. *Paléontologie et Peuplement de la Terre. Nouvel Atlas d'Entomologie, Number 1.*

By R. Jeannel, with illustrations by G. Boca and M. A. Descarpentries. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 101 pp. + 14 plates; text ill. 1946.

ATLAS DES LÉPIDOPTÈRES DE FRANCE. I. *Rhopalocères. Nouvel Atlas d'Entomologie, Number 6.*

By F. Le Cerf, with illustrations by Roger Métaye. Éditions N. Boubée & Cie., Paris. 250 fr. (paper). 115 pp. + 12 plates; text ill. 1944.

ATLAS DES COLÉOPTÈRES DE FRANCE. I. *Carabes, Staphylins, Dytiques, Scarabées. Nouvel Atlas d'Entomologie, Number 9.*

By Luc Auber, with illustrations by Germaine Boca. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 83 pp. + 12 plates; text ill. 1945.

ATLAS DES COLÉOPTÈRES DE FRANCE. II. *Ténébrions, Buprestes, Lampyres, Coccinelles, Taupins, Longicornes. Nouvel Atlas d'Entomologie, Number 9.*

By Luc Auber, with illustrations by Germaine Boca. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 83 pp. + 12 plates; text ill. 1946.

ATLAS DES COLÉOPTÈRES DE FRANCE. III. *Longicornes, Chrysomèles, Charançons. Nouvel Atlas d'Entomologie, Number 9.*

By Luc Auher, with illustrations by Germaine Boca. Éditions N. Boubée & Cie., Paris. 180 fr. (paper). 89 pp. + 12 plates; text ill. 1947.

Fashioned after the same plan as the *Atlas des Parasites des Cultures* previously reviewed here (Q. R. B. 23: 77), these little volumes exhibit the same high quality of workmanship. The three volumes which constitute an *Introduction to Entomology* treat of general anatomy, classification, biology, paleontology, and world distribution. Discussed in turn are the systematic position of the Insecta, the better known theories of their phylogenetic origin, external and internal morphology, embryological and postembryological development, and classification of the higher categories. Under the heading of biology are treated nutrition, excretion, respiration, circulation, sensory perception, tropisms, reproduction, behavior, mimicry, parasitism, learning, and social behavior. The section on paleontology and distribution discusses the subject in considerably more detail than most American general text books.

The volumes on Lepidoptera and Coleoptera, while devoted chiefly to the taxonomy of French species, contain by way of introduction valuable information on structure, biology, methods of collecting, etc.

One feels constrained to repeat that an American counterpart to these delightful volumes would be an asset to laymen and professional entomologists alike. The illustrations, as before, are beautiful and helpful, representing standards of artistry and color-printing far above American standards.

V. G. DETHIER



CHECKLIST OF THE COLEOPTEROUS INSECTS OF MEXICO, CENTRAL AMERICA, THE WEST INDIES, AND SOUTH AMERICA. Part 5. Smithsonian Institution, United States National Museum, Bulletin 185.

Compiled by Richard E. Blackwelder. United States Government Printing Office, Washington, D. C. 60 cents (paper). iv + Pp. 765-925. 1947.



A REVISION OF THE AMERICAN SPECIES OF HOPLITIS (HYMENOPTERA, MEGACHILIDAE). *Bulletin of the American Museum of Natural History*, Volume 89, Article 4.

By Charles D. Michener. American Museum of Natural History, New York. 75 cents (paper). Pp. 257-318; ill. 1947.

With this monograph C. D. Michener adds still another exemplary work to his fine biologic and taxonomic studies of bees. Eight subgenera of *Hoplitis*, a genus of leaf-cutting bees, are recognized within our fauna, encompassing some 24 species and 15 subspecies. Keys are provided to both subgenera and species, and

detailed descriptions are given for each of the taxonomic entities recognized. The range for each species, where at all reasonably well known, is portrayed in distributional maps. Brief treatment is given to the bionomics and phylogeny of *Hoplitis*. In addition there is a more detailed discussion of the possible course of evolution within *Aloidamea*, the more dominant and best known of the subgenera found in North America. Several species are figured in toto; and outline drawings of mandibles, as well as of antennae and apical abdominal segments of males, are provided in illustration of key and descriptive characters.

KENNETH W. COOPER



THE INSECT WORLD.

By Hilda T. Harpster; illustrated by Zhenya Gay. The Viking Press, New York. \$3.00. xii + 211 pp.; ill. 1947.

The author presents a surprisingly informal survey of interesting insects, drawing upon her particular familiarity within this group. The various kinds are introduced in a very natural way in informative discussions of how insects grow, what they eat, how aquatic kinds breathe, or of such special features as protection, camouflage, and homes. The account of crickets in China kept as pets is especially complete, as is a lively introduction to the various silkworms and their culture in Asia and southern Europe. An appendix provides a simple table of ten common orders of insects with their general recognition features, and a survey of some twenty-three different types with descriptions and suggestions as to where to look for them. The style throughout should appeal to readers at the high school level, and make information pleasantly available to parents who are puzzled by the caterpillars and bugs their children bring home and ask about.

LORUS J. & MARGERY J. MILNE



FESTSCHRIFT ZUM 60. GEBURTSTAGE VON PROFESSOR DR. EMBRIK STRAND. Volumes II and III.

"Latvija," Riga. Paper. (II) ii + 652 pp. + 37 plates; text ill. (III) ii + 608 pp. + 20 plates; text ill. 1936-1937.

These two volumes have been greatly delayed in arrival in the United States because of the war. They contain a total of 89 papers written in honor of the arachnologist Embrik Strand by friends and colleagues abroad. The subjects fall almost wholly within the realm of the Arthropoda, paleontological and living, and the papers are published in German, English, French, or Italian.

VARIATION IN THE SKINKS (REPTILIA: LACERTILIA) OF THE SKILTONIANUS GROUP. *University of California Publications in Zoology, Volume 43, Number 4.*

By Thomas L. Rodgers and Henry S. Fitch. *University of California Press, Berkeley and Los Angeles.* \$1.00 (paper). Pp. 169-220; ill. 1947.

When a thorough monographic treatment of a genus appears, investigators, considering it relatively definitive, breathe a sigh of relief, and thankful for the conclusion of a particular segment of work turn their efforts elsewhere. Such a monograph was Taylor's 643-page study of the genus *Eumeces* (1935. *Bull. Univ. Kansas*, 36(14): 1-643, 84 figs., 43 plates). The paper under consideration here is concerned with the skiltonianus group of that same genus *Eumeces*. Its appearance, just a dozen years after Taylor's monograph, is a monument to the labors of the authors, particularly to their extensive field work (largely by Fitch), and thoughtful methods of recording and presenting their data (largely by Rodgers). More than that, it is an indication that taxonomic work is not passé. Sound systematic studies constitute an important and active subsistence, even as the more widely acclaimed experimental phases of biology. Careful work by careful workers—this paper is an example—can contribute much to our store of biological knowledge.

The systematic details recorded are of interest only to specialists in the field. Suffice it to say that there are recognized here three species of *Eumeces*: *skiltonianus*, *lagunensis*, and *gilberti*, the last with four subspecies, one of which is described as new. These skinks range from British Columbia south through Lower California and east into eastern Idaho.

After the introductory material there is a general discussion of habitat and distribution, which is followed by a key. Because of the tremendous ontogenetic variation in these lizards, the authors have deemed it necessary to include the area of collection as part of their identification key. This is unfortunate. There is next a consideration of intraspecific variation: age, sexual, and individual. The discussion of interspecific variation is divided into two parts: size, relative limb length, and scalation and color. There then follows an account of the species, a summary, a list of literature, and plates. Features of the paper include a number of Dice-Leraas graphs and a series of semidiagrammatic colored plates that illustrate ontogenetic changes and sexual dimorphism of color pattern.

Unfortunately there are indications in the monograph of confused concepts (which are widespread in the literature) regarding biometrical analysis, e.g., "...it is possible accurately to determine the individual and group variations only when the series of specimens analyzed are large enough to be treated statistically" (p. 178). All of the common formulae in current use contain an expression for the number of specimens (N), and there are several special correctional

devices for dealing with small samples. It is, in fact, possible to treat single specimens statistically. The number of specimens alone does not indicate satisfactorily whether a reasonable idea of variation may be obtained. Other statistical and biological factors must necessarily be involved. It is, as a matter of fact, quite possible to obtain, for example, a satisfactory estimate of the variation of the labial scales from a series of lizards and yet be unable to obtain a satisfactory estimate of the variation of the dorsal scales from that identical series of specimens.

ARNOLD B. GROBMAN



OCEANIC BIRDS OF SOUTH AMERICA. *A Study of Species of the Related Coasts and Seas, Including the American Quadrant of Antarctica Based Upon the Brewster-Sanford Collection in the American Museum of Natural History. Volumes I and II.*

By Robert Cushman Murphy. *The Macmillan Company, The American Museum of Natural History, New York.* \$17.50. (I) xxii + Pp. 1-640 + 44 plates; text ill.; (II) viii + Pp. 641-1246 + 44 plates; text ill. 1936.

Naturalists who are familiar with this classical work will be pleased to know that it is now available from the Macmillan Company in essentially the form in which it was presented by the American Museum of Natural History (Q. R. B. 11: 351. 1936). The only outstanding change which has been made is that in this printing the color plates and photographic illustrations are not scattered through the text, but are assembled at the end of each volume.

The reviewer would like to comment on this study for the benefit of those who are not yet acquainted with it, for this is no mere check list of oceanic birds. Rather, it represents one of the outstanding accounts not only of the behavior and characteristics of the sea and littoral birds of South America, but of the various geographical and climatic features governing their distribution and activities. The book is presented in two sections that cover both the Atlantic and Pacific sides of the continent, including the adjacent oceanic islands. The first section describes in great, yet significant, detail the various environmental features of the areas studied, while the second and larger portion of the work presents individual life histories of such birds as kelp geese, steamer ducks, and penguins, albatrosses, and petrels. Careful consideration is given to the guano birds and other island forms. The material is presented in an extremely interesting manner, so that the reader feels as though taking part in the various expeditions upon which the work was based.

A final point of note is the vivid picture drawn of the field work involved in extracting information of this

sort from nature and of the spirit that lies behind such work. That spirit is personified not only in Robert Cushman Murphy's own researches, but, as he brings out, also in the collecting of the R. H. Becks and the several others whose endeavors and financial support have resulted in this fine story of life in wild and remote regions.

JOHN E. CUSHING



BIRDS IN THEIR HOMES.

By Addison Webb; Pictures by Subra Mallett Kimball. Garden City Publishing Company, Garden City, New York. \$2.00. 66 pp.; ill. 1947.

A children's book which should interest anyone from five to fifty, this volume tells of the many diverse ways by which the birds have solved their housing problems. From the fastidious hummingbird which uses plant downs, spiderwebs, and lichens for building materials to the lazy cowbird with no nest, the reader is carried through the initial stages of site selection, construction processes, egg laying, and family life of some 25 species of our more common birds. The text is simple yet adequate, and the illustrations, both colored and black and white, are beautifully done. The book should be made accessible to every inquisitive youngster.

C. P. SWANSON



STARLINGS.

By Wilfrid S. Bronson. Harcourt, Brace and Company, New York. \$1.75. 78 pp.; ill. 1948. Written for children, this is nevertheless the kind of book that adults can approve and enjoy. Both text and illustrations are clever and informative. In fact, the bird drawings set a very high standard of achievement both for dramatic appeal and for expertness of draftmanship. And the story of the starlings—their lives and times—is told with a zest, an accuracy, and a lack of sentimentality that sets this book in a class by itself. The entire atmosphere of the book is of good-humored realism. The starlings eat the right foods, the males sing for the right reasons (according to modern theory), and both sexes commit the appropriate nuisances. Anyone who has stopped to hear a starling singing on a winter day will want to see the book, and it should be a must for every school library.

ANN F. MOMENT



BIRDS OF PREY OF NORTHEASTERN NORTH AMERICA.

By Leon Augustus Hausman; Illustrated by Jacob Bates Abbot, Frontispiece by George Miksch Sutton. Rutgers University Press, New Brunswick. \$3.75. xxviii + 164 pp.; ill. 1948.

As the title would imply, the birds concerned in this publication are members of the hawk and owl groups that occur in the northeastern part of North America. This includes stragglers normally found elsewhere, like the sea eagle, but which have been reported on occasion in the northeastern area. In all, 35 species and subspecies are described. This description for each type of bird includes brief plumage notes, length of body and wingspread, general notes on the life history, especially food habits, and distribution. None of these topics is discussed in great detail. Illustrations by Abbot are excellent. An index and bibliography are supplied. The naturalist, sportsman, or farmer will find this a useful book to remind him of the value of these fine birds. In addition, many will enjoy the handsome layout of this book, with its attractive cover and printing.

HENRI C. SEIBERT



THE BIRDS OF NANTUCKET. *New England Bird Studies, Number 1.*

By Ludlow Griscom and Edith V. Folger. Harvard University Press, Cambridge; Geoffrey Cumberlege, Oxford University Press, London. \$3.25. xii + 156 pp. + 17 plates. 1948.

A knowledge of the changes that occur in bird populations over a long period of time is of considerable value and significance, since it offers a means whereby the possible effects of alterations in environmental conditions can be evaluated. Unfortunately, there are scant published data which are sufficiently comprehensive to afford significant comparisons with more recent observations. The senior author of this book, however, has had access to William Brewster's unpublished notes and diaries. Enough information was included therein to enable valuable comparisons to be made on many species of birds on Nantucket Island in 1870 with the bird population present within the last two decades. The junior author has provided the more recent records.

Because of a lack of continuous observation on the island, even today the exact status of many common birds is not certain. Land birds and shore birds are scarce compared to the mainland. As would be expected on an offshore island, there are unusual records of vagrants and casuals. For some species, the reason for the change in population numbers can only be conjectured (except for those birds formerly hunted as game and now protected); for others, interspecific competition, as between laughing, herring, and great black-backed gulls, or changes in environment, as the planting of pines and appearance of the pine warbler, show fairly definite cause and effect.

The introduction discusses climatic factors, land bird migrants, changes in bird life and their causes.

It also provides a historical summary of Nantucket bird students and a digest of ornithological problems that still await solution. The systematic list includes the comparisons already alluded to, special effort having been made to provide definite figures or counts. The bibliography appears to be comprehensive, an index is present, and a detailed map of the island has been included. To illustrate an excellent text, photographs, mostly by the hand of that excellent technician, Alan D. Cruickshank, have been generously supplied.

HENRI C. SEIBERT



WILD BIRD NEIGHBORS.

By Alvin M. Peterson. Wilcox & Follett Company, Chicago. \$2.50. vi + 298 pp. + 1 plate; text ill. 1947.

This book is a popular account of the author's personal experiences with the birds of his region (no locality mentioned). Most of the information deals with the nesting phase in the bird's life cycle. From the number of nests of various species that are discussed, it is apparent that the author has spent many years in the field. Many of the nesting birds were photographed, and considerable space is devoted to a description of the trials and tribulations of the bird photographer. The results of these endeavors illustrate the book, but unfortunately the printing does not do the author full justice. At the risk of being pedantic, one would like to warn readers not to take the author's interpretations of bird behavior too literally. "No doubt this was the way of showing how happy they were [kingbird] . . ." "The cowbird is either too lazy or unskillful to build a nest. . ." "...he [brown thrasher] was so happy he could not refrain from singing, but was wise enough to sing in low tones. . ." Although the author recognizes that there are good and bad birds and that each has its place in the natural scheme of life, yet on occasion he does not hesitate to pass a death sentence on a hawk because it molests the bob-white, or on a blue jay for killing a bluebird. "Naturally, I shot the jay on the spot."

HENRI C. SEIBERT



WILD WINGS.

By Joseph James Murray. John Knox Press, Richmond. \$2.50. 123 pp. + 14 plates. 1947. These sketches of bird life, with but minor revisions, first appeared in *Onward*, the young people's paper of the Presbyterian Church in the United States. The last chapter, "Behold the Fowls of the Air," originally appeared in the *Audubon Magazine*. The material was derived from observations made at home (in western Virginia), in regions of the southeastern part of the

United States (Great Smokies, Dismal Swamp, Everglades, etc.), and in parts of Europe. The last part of the collection is devoted in large measure to a discussion of birds from the Old and New Testaments and the role they played in the allusions and aphorisms of Jesus. The author is a pastor as well as a reputable ornithologist, and after reading his book it is further evident that he is an enthusiastic observer of nature and an excellent writer, a series of traits which, when happily blended together, make for pleasurable reading. The illustrations were taken from the files of the National Audubon Society, and are mostly those of A. D. Cruickshank.

HENRI C. SEIBERT



WHEN I HID IN THE MARSH.

By B. Melville Nicholas. Andrew Dakers, London. 6s. 128 pp. + 25 plates. 1946.

The author has spent many hours wandering in the marshes and moors of England, the favorite haunt of a host of interesting birds. There, hiding in some concealing vegetation or in an artificial blind, he observed at first hand the activities of herons, grebes, snipe, owls, plovers, kingfishers, curlews, marsh warblers, and others. Even some of the marsh-inhabiting mammals, such as the otter, are included in the list. These intimate reports on the lives of these creatures will bring pleasure to nature lovers, whether or not they are personally familiar with the birds in question. The illustrations were chosen from some of England's leading nature photographers, although none is specifically accredited to any individual.

HENRI C. SEIBERT



THE BIRDS OF BREWERY CREEK.

By Malcolm MacDonald; illustrated by Arthur A. Allen and W. V. Crich. Geoffrey Cumberlege, Oxford University Press, London, Toronto, and New York. \$5.00. x + 334 pp. + 23 plates. 1947.

Brewery Creek obtained its name from a plant that is no longer in existence. In place of presses and vats, the area now has a rather wild aspect, even though only a short distance from the heart of Ottawa. It is in this locality that the author describes the bird scene, month by month. Nesting birds are given especial prominence, and their yearly cycle is reported, along with the changing climatic conditions and the progressive change in the flora. These events are written in a highly humorous style, but still with sufficient detail to make it apparent that the author has a keen and accurate eye. His frequent use of references attests to his acquaintance with the literature. Many of us who claim we are too busy to spend much time in the

field should read this book and learn how well a busy man like the High Commissioner for the United Kingdom to Canada can utilize a few spare moments to obtain sufficient information for a highly interesting contribution to bird study. The photographs, some of which are in color, are those of A. A. Allen and W. V. Crich.

HENRI C. SEIBERT



ORNITHOLOGY LABORATORY NOTEBOOK *For recording observations made in the field and studies made in the laboratory on the birds of North America. Fifth Edition.*

By Arthur A. Allen; with drawings by L. A. Fieries, M. D. Pirnie, and William Montagna. Comstock Publishing Company, Ithaca, New York. \$4.00. viii + 256 pp. + 1 plate; text ill. 1947.

This fifth edition of A. A. Allen's field notebook has been expanded, with a view to making it of greater use to classes in the South and West, as well as in the East. It still retains its primary intent of serving an elementary class which is chiefly concerned with the recognition of birds and the first fundamentals of interpreting their behavior. The book contains illustrated keys to the orders, families, and nests of North American birds, life history charts of 104 birds, 24 check lists to be used on as many field trips, and various miscellaneous exercises.

JOHN E. CUSHING



WILD ANIMALS of the Five Rivers Country.

By George Cory Franklin; illustrated by Mary Ogden Abbott. Houghton Mifflin Company, Boston. \$2.50. viii + 271 pp. + 8 plates. 1947.

Here are 18 well-told, gripping stories about American mammals, in the vein of Ernest Thompson Seton. The author knows from long experience both his Five Rivers Country, on the Continental Divide in Colorado and New Mexico, and the animals he writes about. A great deal of animal lore is packed into these tales of antelope, porcupine, gray wolf, dog, wolverine, red fox and gray fox, skunk, beaver, snowshoe rabbit, black woodchuck, bighorn sheep, bob-cat, deer, pack rat, coyote, muskrat and cinnamon bear. This is a grand book for a boy, if his dad will let loose of it long enough for him to read it.

BENTLEY GLASS



CATS AND ALL ABOUT THEM. *Revised Edition.*

By L. H. Fairchild and Helen G. Fairchild, with an introduction by Belle J. Benchley. Orange Judd Publishing Company, New York. \$2.50. 243 pp.; ill. 1947.

This book is excellent for the new owner of a pet and also valuable for those interested in breeding and showing cats. It states in simple terms the everyday things and skillfully discusses the intricate details of the care and breeding of cats. Practical advice is given for the care of the well cat or kitten, and equally helpful are the detailed discussions of diseases and their treatment. The chapters on breeding, registering and showing, and the cattery are valuable to the cat fancier. The illustrations are good. A bibliography and index are quite helpful. The revised edition brings new and useful ideas to the cat owner.

HELEN S. WILLIER



RABBITS.

By Herbert S. Zim; Pictures by Joy Buba. William Morrow and Company, New York. \$2.00. 64 pp.; ill. 1948.

A good book for children on rabbits, centering on domestic rabbits, but considering also their wild relatives. Much information is presented in a simple manner about such topics as the ways to raise rabbits, their uses, and interesting habits. The illustrations are excellent, and add much to the attractiveness of the book.



WHAT ANIMAL IS IT?

By Anna Pistorius. Wilcox and Follett Company, Chicago, New York, and Toronto. \$1.00. 27 pp.; ill. 1947.

Attractive colored pictures of many animals common in zoos are presented, together with a paragraph of description about each. The names of these animals are left for the child to guess or look up in the key. The book is arranged in a way that should be interesting to children.



ELEPHANTS. *Morrow Junior Books.*

By Herbert S. Zim; pictures by Joy Buba. William Morrow and Company, New York. \$2.00. 63 pp.; ill. 1946.

This text deals largely with the trapping and training of elephants and offers many points besides regarding their structure and habits that ought to be of interest to children. The illustrations are fair and show a variety of elephant activities, both in the wild and in association with man.



DESERT ANIMALS.

By Rita Kassin; illustrated by Helene Carter. David

McKay Company, Philadelphia. \$2.50. 26 pp.; ill. 1947.

Children will enjoy this picture book of desert animals of our Southwest. Jackrabbits, iguanas, cactus wrens, roadrunners, horned toads, and other denizens of the arid regions are exceptionally well illustrated, and each has a short verse depicting some characteristic feature that the animal possesses. There can be no doubt that both the artist and the author have had first-hand experience with these creatures.

HENRI C. SEIBERT



THE CYPRINODONT FISHES OF THE DEATH VALLEY SYSTEM OF EASTERN CALIFORNIA AND SOUTHWESTERN NEVADA. *Miscellaneous Publications, Museum of Zoology, University of Michigan, Number 68.* By Robert R. Miller. University of Michigan Press, Ann Arbor. \$2.00 (paper). 155 pp. + 15 plates + 3 maps + 1 table; text ill. 1948.

Probably one of the most curious fish faunas in the world is that found in the isolated springs of the Death Valley region. This fauna is composed of two genera of cyprinodonts, embracing a total of six full species. One species is found only in a small spring, and its total population varies from 50 to 400 individuals. These fishes, relicts of a more extensive Pleistocene water system, show evidence of comparatively rapid speciation, assisted by the smallness of the populations and in some cases the almost continuous breeding period in warm springs. Experiments in raising these fish in a different environment produced F_1 generations with essentially the same characters as natural populations, although there were exceptions which indicated an environmental influence on speciation.

J. W. HEDGPETH



ECONOMIC ZOOLOGY

THE ARTIFICIAL INSEMINATION OF CATTLE.

By John Hammond (Editor), J. Edwards, L. E. A. Rowson, and Arthur Walton. W. Heffer & Sons, Cambridge, Eng. 3s. 6d. (paper). viii + 61 pp.; ill. 1947.

On the inside of the front cover of this tiny book is a statement that "the book is intended for the practical farmer, and the general public, and is not highly technical." Without being technical in the ordinary sense, the authors cover step by step almost every phase of artificial insemination in cattle. Twenty-eight pages of clear, concise English describe the technical methods, and the next 31 pages cover the organization and operation of centers for artificial insemination. If the authors have overlooked a point, this reviewer failed to find it. Obviously these men know their field, for they

include enough detail for the farmer and enough references to give the more technically trained reader a start on the literature of the field.

In addition to simplicity and clarity of language, there are several other points on which the authors have done exceptionally well. The passage on psychological infertility (pp. 48-49) is particularly good. Printing the name and address of the manufacturer or supplier of specialized equipment is an improvement in a practical guide, and covering both the technique of artificial insemination and the organization of such centers makes this small book a complete guide for groups undertaking this rapidly expanding service.

ROBERT K. ENDERS



TRAPPING. *The Craft and Science of Catching Fur-Bearing Animals.*

By Harold McCracken and Harry Van Cleave; illustrated by Howard L. Hastings. A. S. Barnes and Company, New York. \$2.75. xii + 196 pp.; ill. 1947.

Successful methods of trapping North American fur-bearers are described by both an entertainingly written text and pen-and-ink sketches. For each mammal whose fur has any commercial value, whether skunk or black bear, the senior author has outlined its distribution and has included pertinent aspects of its life history. To the junior author has fallen the job of describing the trapping techniques. After reading this book, the inexperienced trapper will agree with the authors that experience is still the best teacher. However, this is not meant to imply that the authors have not succeeded in putting down on paper as much information as written exposition can supply. Furthermore, there is considerable information on the life habits of these important animals.

In discussing distribution, the ranges of the subspecies have been taken up in too much detail for a book such as this, and the space could otherwise have been more profitably used for additional illustrations, especially on skinning and tanning methods. The latter topics should have been described in more detail, for, after all, of what value is it to trap a fur-bearer if its pelt is not properly handled. The final chapter provides miscellaneous hints of a random nature for the outdoor man, such as waterproofing a tent, using a watch as a compass, how to make jerked venison, and the like.

HENRI C. SEIBERT



ANIMAL MORPHOLOGY

BUCHANAN'S MANUAL OF ANATOMY. *Seventh Edition.* Edited by F. Wood Jones; Assisted by F. L. Patterson,

S. Mottershead, T. E. Barlow, F. R. Wilde and Jessie Dobson. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$10.00. viii + 1616 pp. + 49 plates; text ill. 1946.

The first edition of this anatomical treatise appeared in 1906 and was written by A. M. Buchanan, Professor of Anatomy in Anderson's College, Glasgow. It was designed as "a guide to the structure of the human body as it is revealed in the process of dissection" and was a topographic, rather than a systematic textbook, a distinction which is no longer consistently applied in the last edition. The latter has been greatly revised and brought up to date by F. Wood Jones, with the assistance of five of his colleagues from the University of Manchester. The original plan of Buchanan's fine old work has been retained wherever possible. Nearly all of the clear drawings by J. T. Murray for the first edition, extensively deleted and substituted in later issues, have been restored, and over 200 new illustrations have been added, among which a series of splendid x-ray plates are especially noteworthy. The scattered embryological notes of former editions have been largely replaced by a new, concentrated chapter on growth and development. The nearly 300 pages of osteology form an unusually large part of this supposedly topographic manual, but this, really systematic, part contains much interesting information, rarely found in other textbooks.

With 847 textfigures, 48 plates, an extensive glossary, and a list of biographical data, this well-written and clearly printed volume deserves to be recommended to medical students as a useful addition to, though not a substitute for, a systematic textbook of human anatomy.

A. H. SCHULTZ



BONE AND BONES: Fundamentals of Bone Biology. By Joseph P. Weinmann and Harry Sicher. The C. V. Mosby Company, St. Louis. \$10.00. 464 pp.; ill. 1947.

This book, by a pathologist and an anatomist, attempts to summarize our knowledge of bone as tissue, and of bones as organs. It is a compilation of a considerable part of the vast accumulated information on bone derived from clinical, microscopic, roentgenological, chemical, and experimental studies. The volume is very instructive and reliable as far as it has covered the ground, but it represents the broad title only in an incomplete fashion. The account of the "normal structure and growth of bone and bones" is limited to 104 pages, whereas the "pathology of bone and bones" occupies 299 pages. The chapter devoted to normal bones would have benefited by a consideration of the most significant results from investigations in embryology and comparative anatomy. The generous

list of references is useful even though it includes mostly papers in English, only random samples of the German literature, and extremely few titles in other languages. The book is well printed, including most of its 289 illustrations.

A. H. SCHULTZ



THE BRAIN OF THE TIGER SALAMANDER Ambystoma tigrinum.

By C. Judson Herrick. The University of Chicago Press, Chicago. \$5.00. viii + 409 pp. + 1 plate; text ill. 1948.

This book is notable in the history of neurology. In my opinion no other animal except the human has had as complete a coverage of its nervous system as given in this treatise. The uniqueness of the book and its greatness lie in the fact that most of its information is the fruit of more than fifty years of intensive study by one individual whose ability to synthesize pertinent facts is recognized by all. *Ambystoma* was an ideal choice. The great change that occurred in the vertebrate organism from an aquatic existence to a terrestrial one where locomotion radically modified structures is reflected in its nervous system.

In seeking the origin of the cerebral cortex, Professor Herrick found in *Ambystoma* the segment in phylogenetic history which has produced "pay dirt." This comprehensive enterprise, in conjunction with the Coghill program, has placed in the hands of neurologists and physiologists valuable and necessary information, which, with modern technics, will aid in understanding the basic morphologic and behavioral patterns.

The book is divided into two sections. The first part of 122 pages deals with general principles of structure and function of a primitive nervous system, with valuable suggestions regarding higher forms. The chapter on general principles of morphogenesis is as clear a statement regarding morphogenic agencies as the writer has found anywhere. There appear throughout this first part philosophical statements which lend encouragement and enthusiasm for any scientific endeavor. The last sentence in this section reads in part, "... the humanistic values of science must always be acknowledged and cultivated." At the end of the chapter on The Origin and Significance of the Cerebral Cortex, a meaningful statement appears: "Obviously, conventional methods of inquiry must be pushed to the limit of their availability, and in the meantime new formulations of problems must be sought with all the resourcefulness that scientific imagination can command, not neglecting the possibility that some of these formulations may lie outside the frame of current Newtonian and quantum mechanics."

This general description and interpretation will be

of considerable value to neurologists, psychiatrists, physiologists, and others interested in development and behavior. Comparative neurology is no longer an isolated specialty, because it now has the active cooperation of all fields of medicine. This means that the investigation of these specialists may now be synthesized and given meaning. Professor Herrick's book will serve as a guide for such advanced research. He has brought before an interested audience of biologists and medical men the fruit of a long lifetime of endeavor in what appears a very restricted area; but in his hands it is presented in its true light, namely, the genesis of the vertebrate nervous system. From this study, one is helped to comprehend with understanding the complicated nervous system of man.

The second part of 300 pages is restricted to the specialist in comparative neurology and the physiological experimentalist. The material is compiled from previous papers but organized into a unity, namely, the total picture of the neurology of the *Ambystoma* brain. New material has been added. An extensive bibliography which includes pertinent papers for further references brings together most of the material in this field. There are 113 illustrations of the Gross and Microscopic Anatomy as well as the neurological aspects of the salamander brain. With this wealth of accurately described nervous tissue, the salamander may well supplant the frog as an experimental animal.

PAUL G. ROOPE



ANIMAL GROWTH AND DEVELOPMENT

UNE THÉORIE DU CHAMP BIOLOGIQUE CELLULAIRE. *Series D, Bibliotheca Biotheoretica, Volume II.*

By Alexandre Gurwitsch. E. J. Brill, Leiden. 9.00 guilders (paper). 149 pp.; ill. 1947.

This small monograph is divided into two portions. The first, which is the shorter, is devoted to an epistemological analysis of method in biological science. The second presents the theory of a biological field which the author considers a fundamental principle to aid our efforts to comprehend the phenomena of life. The introductory philosophical section represents a modern, logically clear, and sophisticated analysis of a problem which is the basic interest of biologists, and should prove stimulating to those who wish to think this problem through to its depths. The second section, which is the principal part of the book, derives the concept of a cellular field, anisotropic in nature, and acting upon certain molecules which are endowed with excess energy in such a way that the surplus is transformed to kinetic energy. The action of the field can then be defined in terms of vectors; and various phenomena of development, of heredity, of metabolism, of nervous activity, are explained in the terms of such fields. The author relates the origin of the cellular

field to the chromatin. He considers not only that his theory can deal with the data of genetics, but that the classical theory of the gene is inadequate to do so.

Much of the factual evidence on which Gurwitsch bases his theory stems from his acceptance of the validity of the demonstration of mitogenetic rays, and discussion will therefore be of primary interest to those who agree with his interpretations in this controversial matter. All biologists are obviously at perfect liberty to agree, or to disagree, on this subject with Gurwitsch or with any other investigator. Since the issue remains open, however, Gurwitsch might have done well at least to mention, either in text or bibliography, the work of Hollaender, if only for the sake of completeness.

On the technical side, it may be said that the legends for the diagrams are too brief to be adequate and that there are many typographical errors. The book is written in lucid and interesting French. There are many of us, who know no Russian, who would be very pleased if more scientific articles from Moscow were available to us in French.

JANE OPPENHEIMER



THE CIRCULATION IN THE FOETUS. *A Synopsis for Students.*

By Kenneth J. Franklin, Alfred E. Barclay, and Marjorie M. L. Prichard. Blackwell Scientific Publications, Oxford. 2s. 6d. (paper). iv + 28 pp.; ill. 1946.

In 1944, these same authors published a notable monograph carrying the same title. That volume was characterized by systematic treatment of the subject, and included an unusual historical survey and a detailed report of the authors' own investigations on the fetal circulation in the goat. Excellent use of cineradiography was employed in the analysis of the flow of blood into, through, and from the heart prior to and after closure of the ductus arteriosus. This synopsis of that publication has been published in response to a manifest need for it.

One of the student associates in research of the authors suggested to the editor of the *Kings College Hospital Gazette* that a short account of the fetal circulation be published in that journal, for the use of medical and veterinary students and nurses in training. There was an immediate demand for reprints which only a separate publication could supply. This pamphlet, written by Franklin, late dean of the Medical School at Oxford University, is the result. It contains the essential story of the fetal circulation at the time of birth, including a historical survey, an account of the present state of knowledge to which these authors have contributed so importantly, and an estimate of the prospects which lie ahead in this field of investigation. Included are thirteen halftone and

linecut illustrations selected from the original monograph for their clearness and value in pointing up the text.

This little publication should serve well its intended purpose. It is brief, clear, comprehensive, and well worth the price, equivalent to fifty cents in American money. American publishers might well see in this type of publication a means of enlarging the usefulness and extending the audience of many specialized monographs which normally reach but a small number of individuals.

S. R. M. REYNOLDS



ANIMAL PHYSIOLOGY

TEXTBOOK OF PHYSIOLOGY. *Ninth Edition.*

By William D. Zoethout and W. W. Tuttle. The C. V. Mosby Company, St. Louis. \$4.75. 723 pp. + 6 plates; text ill. 1946.

This book is intended to fill the gap between the larger textbooks of physiology and the elementary ones. Such an intermediate position is difficult to attain without losing the virtues of the extremes, but the authors have been quite successful in their undertaking. In some sections, as in the chapters dealing with peripheral nerve and muscle function, it seems that the space allotted has been devoted merely to definitions and vocabulary, and that little has been said regarding the basic mechanism of function. In many instances, however, the treatment is good, and all the information is given that students of dentistry, pharmacy, or those attending normal schools are expected to retain. The scope of the book is broad. I believe a greater depth of treatment could have been attained had some of the space now devoted to anatomical and biochemical matters been employed otherwise. On the other hand, many of the emphases are rather nicely calculated to meet the requirements of that group for which the book was written.

CHANDLER McC. BROOKS



ON THE CONTRIBUTION OF CLINICAL STUDY TO THE PHYSIOLOGY OF THE CEREBRAL MOTOR CORTEX. *The Victor Horsley Memorial Lecture, Delivered at the National Hospital, Queen Square, November 27, 1946.*

By F. M. R. Walshe. E. & S. Livingstone, Edinburgh; The Williams & Wilkins Company, Baltimore. 50 cents (paper). 32 pp. 1947.

This lecture is devoted to a commendation of various concepts which had their origin in clinical investigation, and to a criticism of those physiologists who speak of the cortical representation of anatomical elements of the body. By ascribing to these experi-

mental physiologists ideas which are absurdly simple and which they do not hold, the lecturer endeavors to make a case for the cortical representation of "movements" instead of "muscles." He states: "In short, the notion of a cortical representation of structure as such, whether a muscle or a dermatome, is an ontological absurdity." He does not seem to feel that it is at all absurd to think of movements without muscles. It seems to me that the author could have produced something much more worthy of attention had he taken time to realize that the concepts of these individuals whom he criticizes are not vastly different from his own. A better lecture would have resulted had he devoted his considerable ability to a consideration of the mechanisms whereby the cortical representations of anatomical units are so interrelated or interconnected in their activity that patterns of reactions occur rather than the isolated uncoordinated responses of units when the cortex is excited. The author speaks of cortical representation as being in perpetual flux. Experimental physiologists can certainly agree with that, as he later defines it; but they cannot agree that all portions of the cortex are equally important to all functions. This flux has its anatomical and physiological limits, and the author probably does not mean to imply that it is otherwise. The reviewer does not wish to detract from the glory of those praised nor does he wish to minimize the importance of the idea that the body reacts as a whole and that reactions are of an extensive, coordinated nature. Nevertheless, it should be stated that the work of the experimental physiologists has been summarized in such a completely inadequate and unsympathetic manner that the lecture is not very satisfying.

CHANDLER McC. BROOKS



LA CHALEUR ANIMALE. "*Que Sais-Je?*" *Le Point Des Connaissances Actuelles*, Number 205.

By André Missenard. Presses Universitaires de France, Paris. 75 fr. (paper). 128 pp.; ill. 1946.

This small volume is subdivided into four parts. The first deals with the maintenance of a uniform body temperature, the second part with the sensation of heat and its influence on human activity, the third with the general influence of environmental temperature on the health and behavior of homotherms, and the fourth part is devoted to climatic considerations. Each of these sections consists of a few short chapters which deal very succinctly with the variations of body temperature upon exposure to heat and cold, acclimatization, resistance to environmental extremes, temperature and human comfort, mechanisms of heat loss and retention, artificial regulation of temperature and civilization, the geographic limits of desirable climatic conditions, temperature as an economic factor,

and many other topics. It is indeed a very interesting little treatise, containing much useful information.

CHANDLER McC. BROOKS



TEXTBOOK OF ENDOCRINOLOGY.

By Hans Selye, with a Preface by Bernardo A. Houssay. *Acta Endocrinologica, Université de Montréal, Montréal.* \$12.80. xxxii + 914 pp.; ill. 1947.

Hans Selye has attempted to summarize our present knowledge of the endocrines in a textbook, profusely illustrated and highly informative, which gives an excellent over-all picture of the physiology, pharmacology, and pathology of the endocrine glands. As Professor Houssay states in the preface: "In addition to being a text, the book is also an atlas since it contains illustrations of everything that can be photographed (histology, crystals of hormones, experiments, X-rays of clinical cases)." The illustrative material is well chosen and superbly reproduced. The main facts and theories of endocrinology are presented in a well organized fashion, and most of the chapters will prove to be a valuable guide both for the beginner and the advanced student. In other chapters, however, this reviewer has found some quite misleading inaccuracies. For instance, Selye states: "It appears that the testes of the Sebright (and of similar breeds) normally produce folliculoids which cause hen-feathering" (p. 621). This assumption is not in agreement with the experimental findings that a castrated Sebright male having acquired cock plumage becomes hen-feathered under the influence of an implanted Leghorn testis, and that the male plumage of a Brown Leghorn does not become hen-feathered under the influence of a grafted Sebright testis. These results rule out the production of estrogens (folliculoids in Selye's terminology) and indicate that the difference in the plumage is merely due to a difference in reactivity of the feather germ in the two races. It is this difference in the reaction of the end organ which led Fuller Albright to introduce the term "Sebright bantam syndrome" for a disease with a curious deficiency of end-organ response, pseudo-hyperparathyroidism. Selye has missed this concept entirely and in discussing patients suffering from pseudo-hypoparathyroidism he states: "Because of their peculiar appearance (round face, rather thickset figure), the term 'Sebright bantam syndrome' was chosen to describe them" (p. 569). Does the author imply that patients suffering from hypoparathyroidism resemble the Sebright bantam breed of fowl in outward appearance?

The discussion of hypothyroidism in children is hardly adequate. No mention is made of the fact that the cretin is not only stunted in height, but that body proportions remain infantile. In discussing the X-ray

signs of cretinism, mention is made of the delayed appearance of the centers of ossification, but not of the diagnostically important epiphysial dysgenesis. Furthermore, Selye claims that in children suffering from hypothyroidism the daily dose of desiccated thyroid should be raised from 0.1 grain at 6 months to 1 grain at puberty. Most clinicians who have had some experience in the management of hypothyroid children find this dosage wholly inadequate.

It is not the intention to point out every minor error in an otherwise excellent book. The references given are few, but well chosen. They include books and papers written in the English, French, Dutch, Spanish, Portuguese, and German languages. Much thought and labor has gone into the preparation of the index. Under the author's name we find the entry: "see: what next?" Under "what next" appears the entry: "see: Selye." This reviewer hopes that what next will be a carefully revised second edition of this splendid book.

WALTER FLEISCHMANN



A CONTRIBUTION TO THE KNOWLEDGE OF THE INFLUENCES OF GONADOTROPIC AND SEX HORMONES ON THE GONADS OF RATS. *Monographs on the Progress of Research in Holland During the War.*

By J. H. Gaarenstroom and S. E. De Jongh. *Elsevier Publishing Company, New York, Amsterdam.* \$3.00 (paper). viii + 164 pp. + 8 plates. 1946.

This is one of a series of twenty-four monographs, so far announced, dealing with Netherlands wartime scientific work. It is an attractive, pocket-sized booklet that includes twenty pages of abstracts of endocrinological interest for the period 1940-44, which is represented largely by gaps on the library shelves. The main part of the volume is given over to a description of very numerous experiments bearing on the subject matter of the title, in which the authors have rather more scope than is usually available in scientific papers for discussion and theorizing. Their main contention is that the action of gonadotrophic hormones on the testis is, in part at least, mediated by the male sex hormone, testosterone, acting locally on the tubular apparatus. Work appearing concurrently in this country would appear to have supported this idea, and local effects of androgens on the testis have now been demonstrated for several species, including the primate *M. rhesus*.

The authors have extended their thesis to the ovary, where the case for a favorable effect of estrogenic hormones on follicular development is admittedly more speculative. Those interested in this field should be able to follow the authors' close reasoning with pleasure and profit. Die-hard advocates of a single pituitary gonadotrophin are moreover confounded by a "seem-

ingly irrefutable proof" of the existence of two. A further favorable word should be said for this type of unpretentious and presumably inexpensive publication for the dissemination of ideas.

H. R. CATCHPOLE



LE SEL EN BIOLOGIE. *Étude d'Ensemble sur le Chlorure de Sodium en Physiologie et en Pathologie.*

By P. Louyot, préface by Professeur Loeper. Masson et Cie., Paris. 500 fr. (paper). iv + 254 pp.; ill. 1947.

This book on salts, especially sodium chloride, deals with the physiological and pathological aspects of these substances in the human body. It is a non-technical text written in an elementary style. It contains the names of many workers, but the bibliography is relatively small for so large a subject (some three hundred references).

The scope of the book is indicated by the four main sections into which the text is divided. Part One is concerned with the occurrence of salt in blood, tissues, and body fluids during health. Absorption, transportation, partition, and elimination of salt are likewise discussed. Part Two is concerned with the fate of salt in various pathological states. Conditions discussed are: (1) faulty renal elimination (nephritis, Addison's disease, diabetes insipidus, and diabetes mellitus); (2) excessive loss by routes other than the kidney (vomiting, diarrhea, sweating, ascites, and so forth); and (3) dysfunctions of movement and partitioning of salt in the body (infections, shock, edema, neurogenic and endocrine factors, and other diverse conditions). The third part of this volume is concerned with concepts of pathogenicity of salt metabolism. The fourth part gives the author's estimate of therapeutic rationales whereby dechlorination and rechlorination may be accomplished.

It would seem that this volume would be of most value to clinicians who desire a comprehensive review of a large and important subject and a current survey of up-to-date viewpoints. Being written in French, it will of necessity be useful primarily to physicians in French-speaking countries.

S. R. M. REYNOLDS



CURARE: *Its History, Nature, and Clinical Use.*

By A. R. McIntyre. The University of Chicago Press, Chicago. \$5.00. viii + 240 pp. + 1 plate; text ill. 1947.

The first four chapters of this book deal with the discovery and the early history of the study of this famous South American arrow poison and are most interesting and instructive. The work done upon the botanical identification of the curare plants is likewise

well described. Chapter five, which describes the chemical studies aimed at identifying the chemical nature of the poison, is quite adequate. It is only when one reads the chapters dealing with the effects of the curare drugs on function of nerve, muscle, circulation, respiration, and viscera that an impression of inconclusiveness is obtained. It is quite probable that much of the work has been inconclusive and contradictory, but the author has contributed no synthesizing ideas to help to bring clarity out of chaos. Chapters and topics are clearly summarized, but more could have been done to clarify the present state of knowledge about the effect of curare on the nerve muscle junction, because much excellent work has been done recently on the physiology of the end plate and the effect of curare on the end plate potentials. Several important papers dealing with this subject were not referred to. One infers, from the references given, that not much work has been done during the last ten years in several of the surveyed fields. The discussions of certain miscellaneous effects of curare and particularly the effects on the central nervous system are interesting and suggest new work that should be done. The chapter which deals with the clinical use of curare is well written and adequate. On the whole, this book is a valuable contribution and will serve well as a reference work. It should stimulate and aid future investigations.

CHANDLER McC. BROOKS



DETOXICATION MECHANISMS. *The Metabolism of Drugs and Allied Organic Compounds.*

By R. Tecwyn Williams. John Wiley and Sons, New York. \$5.50. viii + 288 pp.; ill. 1947.

The object of the author has been to gather together in this book, in orderly fashion, the available information on the metabolic fate of organic compounds foreign to the body. The ultimate aim of such a review would be to provide working hypotheses that may serve as guides for subsequent studies. A comprehensive summary of the subject matter is presented in the opening chapter, and certain theoretical considerations and conclusions are made in the final chapter of the text.

The subject is approached in methodical fashion, beginning with the metabolism of the aliphatic compounds, followed by that of aromatic hydrocarbons and halogenated derivatives. Subsequent chapters are concerned with the metabolism of: phenols; aromatic alcohols, ethers, aldehydes, ketones, and amides; aromatic acids; organic cyanides; aromatic nitro, amino, and azo compounds; sulphones, sulphonic acids, and sulphonamides; terpenes and camphors; heterocyclic compounds and the organic compounds of arsenic.

The biochemical changes that have become known

as detoxication mechanisms are essentially metabolic in character. The term is not entirely satisfactory. It implies a decreased toxicity of a particular substance upon metabolism in the animal body. This is not always the case, as in fact some compounds are rendered more toxic upon metabolic breakdown. The author suggests the use of the terms "hypertoxic," "isotoxic," and "hypotoxic," whenever it would be advantageous to do so. A cursory review of a number of current pharmacology textbooks indicates that the term detoxication is not frequently employed. *Chemical Abstracts*, however, includes in the index a listing of compounds under this heading.

The book may be useful to investigators interested in the toxicity of medicinally important compounds. It is quite clear, however, that the accumulated knowledge permits only very broad generalizations to be drawn regarding the metabolic fate of most foreign organic compounds in the animal body.

C. JELLEFF CARR



OUT OF THIS WORLD. *Anesthetics and What They Do To You.*

By Sylvan M. Shane. *Creative Age Press, New York.* \$2.00. xvi + 111 pp. + 4 plates. 1947. The author has made an effort to present to the layman the phenomenon of anesthesia in a style that will engross his attention. The book is written in the form of a story. It depicts the average man going into the hospital for a surgical operation. It describes his fears and points out the important role that the anesthesiologist plays in the obtunding of pain and the safeguarding of the life of the patient.

The various types of anesthesia, such as intravenous pentothal, cyclopropane, and ether-oxygen, are briefly described. The chapter entitled *The Silver Cord Is Severed* describes the production of spinal anesthesia. The third part of the book discusses the romance of anesthesia, beginning a century ago, and listing the important events in a summarized form up to the year 1946.

The book is intended primarily for the layman. Its style is lucid, and it appears to be a useful volume for allaying the fears of the layman with regard to anesthesia, and inspiring his confidence in the science and art of anesthesiology.

JOHN C. KRANTZ, JR.



THE RH FACTOR IN THE CLINIC AND THE LABORATORY. *Special Issue Number 2 of Blood, The Journal of Hematology.*

By Joseph M. Hill and William Dameshek. *Grune*

and Stratton, New York. \$4.25. viii + 192 pp.; ill. 1948.

This special issue, in a permanent binding, contains the papers presented at the International Hematology and Rh Conference held in Dallas and Mexico City in November, 1946. The contents are as follows: Preface (W. Dameshek); A Survey of the Significance of the Rh Factor (P. Levine); The Rh Genotypes and Fisher's Theory (R. R. Race); Hemolytic Mechanisms (W. Dameshek); Generalities on the Nucleolar Content of Some Blood Cells (I. G. Guzmán); Interrelationship between the Rh System and the A B System (E. Witebsky); Hemolytic Rh Immune Globulins: Evidence for a Possible Third Order of Antibodies Incapable of Agglutination or Blocking (J. M. Hill, S. Haberman, and F. Jones); Acute Renal Insufficiency Due to Incompatible Transfusion and Other Causes, with Particular Emphasis on Management (E. E. Muirhead, A. E. Haley, S. Haberman, and J. M. Hill); Rh Antibodies; Correlation with Clinical Findings (I. Davidsohn); On Certain Variations in Erythroblastosis Fetalis (B. Chown); The A and B Factors as a Possible Cause of Erythroblastosis (A. C. V. Orozco); The Treatment of Erythroblastosis Fetalis by Substitution Transfusion (H. Wallerstein); Current Problems Regarding the Rh Factor (general discussion); Historical Review of Mexican Blood Transfusion (E. U. Guerola). The volume has an index.

This volume will be an essential reference for hematologists, immunologists, and geneticists studying man. The publishers are to be thanked for providing the special issue in so substantial and attractive a format.

BENTLEY GLASS



STUDIES ON CARBOHYDRATE AND FAT METABOLISM. *With Especial Reference to the Pigeon. Carnegie Institution of Washington Publication 569.*

By Oscar Riddle and associates. *Carnegie Institution of Washington, Washington, D. C.* \$2.25 (cloth); \$1.85 (paper). vi + 128 pp. 1947.

This is an account of the specialized researches of the Cold Spring (Carnegie) group on other phases of pigeon physiology and endocrinology. Briefly summarized are some of the differences between avian and mammal.

H. R. CATCHPOLE



ENDOCRINES AND CONSTITUTION in Doves and Pigeons. *Carnegie Institution of Washington Publication 572.*

By Oscar Riddle. *Carnegie Institution of Washington, Washington, D. C.* \$4.00 (cloth); \$3.00 (paper). xii + 306 pp. + 1 plate; ill. 1947.

The author's name will be associated with numerous papers on the physiology and endocrinology of these avian forms, that have appeared during the past years. The present volume represents the results of a 24 year study. Briefly, the first half of the book describes methods used to segregate certain constitutional factors having relation to the endocrines; e.g., responses to prolactin, testis weight, egg weight, etc. In this way a series of "physiological races" was built up. In the second part, the effect of race, sex, age, etc., on basal heat production was dealt with. Each of the 18 chapters consists of detailed presentation of graphs and tables, and each carries an introduction and a short summary. Readers interested in these various phases will probably find it convenient to dig into the pertinent sections piecemeal, since a general synthesis was not made and was hardly to be expected. A concluding statement points to the marked biological inequality of the dove races developed in this programme. The author sees evidence in this for the idea of a genetical and biological inequality of human individuals, types, and races supported by "a few anthropologists."

H. R. CATCHPOLE



ANIMAL NUTRITION

PROTEINS AND AMINO ACIDS IN NUTRITION.

Edited by Melville Sahyun. Reinhold Publishing Corporation, New York City. \$7.50. xvi + 566 pp.; ill. 1948.

The editor and seventeen outstanding authorities in special fields have prepared the fifteen chapters of this timely book. The Introduction is by H. B. Lewis. Succeeding chapters are: Proteins in Nutrition (Historical) (E. F. Beach); The Biological Utilization of Proteins and Protein Requirements (H. H. Mitchell); Caloric, Vitamin and Mineral Requirements with Special Reference to Protein Nutrition (H. J. Deuel, Jr.); Economic Aspects of Food Proteins (L. E. Booher); The Nutritive Aspects of Meat and Meat Products (H. R. Kraybill); The Amino Acid Requirements of Avian Species (H. J. Almquist); The Relation of Hormone to Protein Metabolism (A. White); Plasma Proteins and Their Relation to Nutrition (M. Sahyun); Protein Deficiency and Its Relationship to Nutritional Anemia, Hypoproteinemia, Nutritional Edema, and Resistance to Infection (C. P. Berg); Protein and Amino Acid Nutrition in Pediatrics and in Pregnancy (S. Z. Levine); Protein Nutrition in Surgical Patients (C. C. Lund and S. M. Levenson); The Relation of Fluid and Mineral Balance to Protein Metabolism (W. E. Abbott); Proteins as Related to Burns (A. Large and C. G. Johnston); The Protein Nature of Toxins, Antitoxins and Related Substances (E. A. Kabat);

Protein Nature of Filterable Viruses (M. A. Lauffer). Appendix: Table 1, Proximate Composition of American Foodstuffs; Table 2, Nutritive Value of 100 Grams of Selected Foods, Edible Portion; Index.

This volume will be read with interest by biochemists, physiologists, teachers of nutrition, and members of the medical profession. It is an excellent and authoritative work.

E. V. MCCOLLUM



LE DOSAGE MICROBIOLOGIQUE DES VITAMINES. *Médecine et Biologie, Number 1.*

By Maurice Welsch; edited by Marcel Florkin. Editions Desoer, Liège. 100 fr. (paper). 193 pp. 1947.

This small volume presents a selection of the best known procedures for the microbiological assay of thiamin, riboflavin, nicotinic acid, pantothenic acid, pyridoxine, biotin, folic acid, i-inositol, and p-aminobenzoic acid. There are taxonomic and alphabetical indexes. This book is not likely to be of much service to those engaged in the assay of vitamin preparations because there are now available far more comprehensive and critical books which cover this field of inquiry. There is an insert page which calls attention to errors of typography on twenty pages. There is a short bibliography at the end of each chapter.

E. V. MCCOLLUM



ESTIMATION OF THE VITAMINS. *Biological Symposia, Volume XII.*

Edited by W. J. Dann and G. Howard Satterfield. The Jaques Cattell Press, Lancaster, Pennsylvania; The Ronald Press Company, New York City. \$6.50. x + 531 pp.; ill. 1947.

This volume contains twenty-nine chapters, each written by one or two persons who have studied critically the methods which they discuss. Methods based upon physical and chemical, biological and microbiological techniques are described and appraised on the basis of the experience of the contributors and the recorded experience of others.

The fifteen best characterized vitamins are discussed in the volume. Anyone who studies this book will find the recommended method for assay of each vitamin, a critical discussion of the details involved, and conclusions as to its merits and limitations.

It is not apparent to the reviewer how the subjects could have been treated more effectively to improve the usefulness of the book. Everyone who is engaged in any way in work with vitamins will find it a source of reliable information on almost any question likely to

arise in the present state of knowledge. It should find wide acceptance.

E. V. McCOLLUM



LITERATURE SEARCH ON THE PRESERVATION OF FOODS BY FREEZING. *First Supplement, January, 1946-July, 1947. Special Report Number 25.*

By Betty Anderson and B. H. Weil. *State Engineering Experiment Station, Georgia School of Technology, Atlanta.* \$3.00 (paper). viii + Pp. 407-670. 1948.



BIOCHEMISTRY

LES INOSITOLS. *Chimie et Biochimie.*

By Paul Fleury and Paul Balatre. *Masson et Cie., Paris.* 300 fr. (paper). ii + 166 pp. 1947.

In this useful volume the authors have compiled and discussed the experimental data to be found in the original literature upon every aspect of the chemistry and biochemistry of i-inositol and its isomers. All of the facts available relating to the physical properties of the ten isomers of 1,2,3,4,5,6-cyclohexane-hexol, their synthesis, and degradation are recorded. The naturally occurring derivatives of i-inositol are also described. There are separate chapters on the significance of this substance and its derivatives in the plant and animal kingdoms. The literature on the bacterial and animal metabolism of i-inositol is discussed. There is a bibliography of 419 titles. This small volume will be welcomed by investigators in plant and animal physiology, bacteriologists, and biochemists.

E. V. McCOLLUM



THE SULFONAMIDES AND ALLIED COMPOUNDS. *American Chemical Society Monograph Series.*

By Elmore H. Northey. *Reinhold Publishing Corporation, New York.* \$12.50. xxviii + 660 pp. 1948.

This monograph has required years to write. It is an outgrowth of previous reviews by the author published in 1939 and 1940. An attempt has been made by Northey to cover adequately the chemical side of sulfonamide chemotherapy. As pointed out in the preface, "progress has been so rapid and the number of new compounds synthesized so great, now over 5000, that it has been all but impossible for chemists active in the field to keep up with developments." The author's aim has been also to provide pharmacologists and clinicians with data on the activities and

important properties of these drugs. A further aim has been to provide research workers in general with a brief summary of the medicinal uses and limitations of those sulfonamides that have come to clinical trial. The value of such information lies in the suggestions that may be prompted thereby for new compounds of still greater merit.

The status of sulfonamide therapy is sharply revealed by the figures cited by Northey on sulfonamide drug production in the United States in 1943, when over 10 million pounds of these compounds were manufactured. It is estimated that this figure (representing a war year) is now considerably reduced, owing in part to the advent of antibiotic therapy.

It would be unfair to prospective users of this volume to cite Northey's dramatic illustrations of the accomplishments of sulfonamide chemotherapy in acute infectious diseases. The reader may enjoy these for himself. The author's contribution, along with that of those whose names are listed in the bibliography, will serve as a monument to their memory.

A list of monographs and reviews concerned with the medical literature of sulfonamide chemotherapy published prior to and during 1944 is given in the preface. Over 2600 references (largely chemical) to the literature are cited in the bibliography. A list of 39 of the more important journals that have been searched—through 1944—is given in the back of the volume. In the appendices a rather complete key to organisms and diseases is set forth. Trade names for sulfanilamide (sixty in number) and the trade names for the other sulfonamides are also provided in tabular form.

In this undertaking the author has been assisted by Dr. Harold J. White, who wrote the chapter on the measurement of chemotherapeutic activity, and Dr. J. T. Litchfield, Jr., who wrote the chapter on the pharmacology of the sulfonamides and sulfone drugs. Dr. Benjamin W. Carey is given the responsibility for the chapter on the clinical evaluation of sulfonamide drugs.

The book is divided into twelve chapters. A historical review of the subject is presented in one chapter. The major portion of the text is devoted to the nomenclature, classification, synthesis, structure and activity of the sulfonamides and sulfones. The chapters concerned with the experimental evaluation and pharmacology of these drugs will be most valuable to workers in this field. The sections devoted to the relationship of structure to chemotherapeutic activity and theories of the mechanism of action of sulfonamide drugs will be useful reference sources for students of the subject.

In the opinion of the reviewer this monograph is a monumental work; replete as it is with tabular material from so many sources, it should serve well to provide the synthetic organic chemist, the bacteriologist, the

pharmacologist and the worker in the field of experimental therapeutics with a comprehensive reference source.

C. JELLEFF CARR



MICROBIOLOGY

BERGEY'S MANUAL OF DETERMINATIVE BACTERIOLOGY. Sixth Edition.

By Robert S. Breed, E. G. D. Murray and A. Parker Hitchens. The Williams & Wilkins Company, Baltimore. \$15.00. xvi + 1529 pp. 1948.

Since all other treatises on bacterial systematics are now too old to be used for determinative purposes, *Bergey's Manual* has become an indispensable work of bacteriological reference. It is accordingly gratifying to discover that the present version, although not without blemishes, constitutes an enormous improvement in many respects over previous editions.

Considerable changes have been made in the main outlines of classification. Some of them reflect a clearer perception of natural relationships, the most notable instance being the abandonment of the artificial order *Thiobacteriales* and the redistribution of the very heterogeneous assemblage of organisms previously included therein, an approach which has made it possible to place the photosynthetic bacteria in the *Eubacteriales* along with their colorless morphological counterparts. Such steps in the direction of establishing natural major groups have been accompanied by a significant innovation: the liberal use of supplements and appendices in cases where genera and families whose relationships are unknown or uncertain can be described without being assigned to a definite position in the system as a whole. Considering our relative ignorance of bacterial phylogeny, this modest and tentative approach to the thornier problems of the subject contrasts favorably with the practice in earlier editions, where virtually all known bacteria were forced (often by somewhat Procrustean methods) into a rigid taxonomic framework. The use of supplements and appendices in this manner serves a valuable purpose by emphasizing taxonomic regions that are still terra incognita, but at the same time it brings in its train determinative problems which have not been satisfactorily solved in the present volume. When a substantial percentage of the bacteria are provisionally located, it is essential that an adequate system of determinative keys be provided. This the editors have failed to do. There are many organisms which cannot be tracked down by following the keys and whose discovery requires either intuition or a thorough knowledge of the *Manual* as a whole. The index of sources and habitats that has been added to the present edition should be of some help in locating unkeyed groups, but it is by no means an adequate substitute for

a system of multiple keys. This is a deficiency that should be easily remedied in the future.

One novelty of which this reviewer heartily disapproves is the appearance (though admittedly in the shy seclusion of a supplement) of a new order *Virales*, subdivided into families, genera, and species, all provided with Latin designations according to the accepted rules of taxonomy. This implies a far more definite understanding of the origin and nature of viruses than most workers with these entities would be willing at present to concede, and its determinative utility is far from evident. In any case, the *Manual* is alleged to be a treatise on determinative bacteriology, and is thus hardly the most suitable vehicle for this curious taxonomic exercise, unless the editors plan an extension of the class *Schizomycetes* to include acellular entities.

In the treatment of many individual genera and families there have been marked improvements, reflecting the success of the editors in obtaining the services of specialists for this revision. As shown by the lengthy list of contributors appended to the title page, the *Manual* has now become a truly coöperative venture; although the taxonomic skeleton remains a matter for editorial decision, the detailed systematic presentations that clothe it are the work of many. Not the least valuable parts of these contributions are the explanatory essays that accompany some of them. The reviewer particularly enjoyed F. Smith's account of the problem of speciation in the genus *Salmonella* and van Niel's lucid analysis of the confused taxonomic history of the photosynthetic bacteria. The fine general introduction to the *Myxobacteriales*, prepared by Buchanan for the fifth edition, has been revised and extended. Similar introductions to the other orders would greatly enhance the value of future editions.

There still remain large sections whose treatment is inadequate, but in many cases (e.g., the families *Achromobacteriaceae* and *Bacteriaceae*) the trouble stems from a lack of information about the bacteria concerned. This excuse cannot be offered, however, for the family *Lactobacteriaceae*. As originally conceived by Orla-Jensen, it was one of the few really satisfactory larger assemblages of true bacteria, clearly defined on the basis of many common properties, both morphological and physiological. Its boundaries have now been extended to include a motley collection of genera and species having little in common either with the true lactic acid bacteria or with one another, and in some cases not according with the definition of the family, even though this has been revised to make it more widely inclusive. It is to be hoped that in the next edition the *Lactobacteriaceae* will be restored to its original form and the present strangers within its gates given other accommodation—in most cases, an easy task.

In spite of the criticisms offered above, it should be

recognized that the present revision of the *Manual* is a monumental achievement. Probably no bacteriologist will be wholly satisfied with it, but all will be grateful to the editors for the time and effort that they have put into this indispensable book.

R. Y. STANIER



ATLAS OF BACTERIOLOGY.

By R. Cranston Low and T. C. Dodds. *The Williams & Wilkins Company, Baltimore.* \$8.50. viii + 105 pp.; ill. 1947.

This atlas, printed on luxurious paper, is mainly a collection of drawings of bacteria and bacterial cultures as the medical technologist sees them after standardized and often brutal treatments. The accuracy of reproduction is remarkable, the usefulness questionable when we realize that ability in practical laboratory diagnosis can only result from long practice on the part of the technician. The general practitioner will find this atlas useful in understanding the meaning of terms and descriptions used in textbooks of medical bacteriology and pathology.

As for the bearing of the illustrations of bacterial cells on bacterial cytology, the relation is about that of a photograph of a positive Fehling reaction in the test tube to the structural formula of glucose. It is actually this routine deformation of bacterial cells for the purpose of diagnosis that has been responsible for the regression of bacterial cytology dating from the middle of the 19th century until a few years ago. It is only thanks to the efforts and tenacity of a few almost ignored cytologists that bacteriologists are beginning to see now in bacteria about as much as Leeuwenhoek and de Bary used to see in their days. There is a crying need for a true bacterial cytology upon which to build a science of bacteria as living things.

S. E. LURIA



* BACTERIOLOGY. A Textbook of Microorganisms. Fourth Edition.

By Fred Wilbur Tanner and Fred Wilbur Tanner, Jr. *John Wiley & Sons, New York; Chapman & Hall, London.* \$4.50. x + 625 pp.; ill. 1948.

This textbook has some good features in comparison with other current textbooks of bacteriology. It contains much needed review chapters on cell structure, plant and animal biology, molds and yeasts. The chapter on protozoa is fully inadequate, even for an understanding of modern ideas on comparative metabolism. Beyond that, in dealing with bacteria, this book has little to offer besides the exasperating dullness and platitudes of most similar textbooks. Can it be that the crisis of bacteriological writing stems from the

attitude of most bacteriologists toward bacteria? Zoologists and botanists, as a whole, are naturalists, that is, they love living things. Bacteriologists seem to suffer from a sort of ancestral hatred for bacteria, possibly rooted in the tradition of medical bacteriology. This seems particularly true of textbook writers: there is more feeling for bacteria in Rahn's popular *Microbes of Merit* than in any or all of five textbooks lying on this writer's desk.

The innumerable factual inaccuracies, mostly due to lack of critical reevaluation of old data (see, for example, the paragraph on the chemical composition of bacterial capsules, p. 103), are secondary to the irrelevance and hearsay character of most of the information given. In a book with the subtitle: "Fundamental facts and principles for the first course in bacteriology," we find no mention of nucleoproteins, 19 lines on "Constitutive and Adaptive Enzymes," 8 lines on "Mutations," 26 lines on "Microbic Dissociation," and one and a half pages on "Cucumber pickles." Maybe what is wrong with too many bacteriologists is that they are not interested in "fundamentals," and are less fond of bacteria than of cucumber pickles.

S. E. LURIA



FUNDAMENTAL PRINCIPLES OF BACTERIOLOGY. Third Edition.

By A. J. Salle. *McGraw-Hill Book Company, New York, Toronto, and London.* \$6.00. xii + 730 pp. + 1 plate; text ill. 1948.

The third edition of this standard text presents features which should make it of great value in certain respects. As mentioned on the dust jacket, it "emphasizes the importance of chemistry for a clearer understanding of the composition of bacteria and the reactions they produce."

The reviewer is in general agreement with this emphasis. The time has long passed when a bacteriologist could "get by" without a fundamental knowledge of chemistry, especially organic chemistry. It is perhaps a distortion to claim that bacteria are merely and solely "chemical machines," but so much of the activity of bacteria is chemical that a good grasp of chemistry is essential for the present-day bacteriologist, just as a solid knowledge of mathematics is essential for most forms of engineering.

Possibly the strong chemical emphasis of the book may even serve to limit its usefulness to some extent. At a rough guess, the chemistry involved would be about equal to that attained by a third year student of the chemical sciences. If this interpretation is approximately correct, then as a primary text the book would be appropriate mainly for chemists approaching bacteriology in their fourth year of college. However, it should be of immense value to graduate

bacteriologists who wish a better grasp of the fundamental chemistry of their science, and of supplementary value to those with lesser training in chemistry.

Some minor criticism of the chemical material is in order. The data on folic acid (p. 250) are 3 or 4 years out of date. It may be questioned whether formaldehyde (p. 210) acts as a germicide by reason of its reducing properties. More probably it acts by combining with proteins. The praise of sulfanilamide as a dusting powder for war wounds (p. 221) is outdated. Owing to caking of powdered sulfonamides, their local use in wounds caused much trouble in World War II. Accordingly, in the last stages of the war, their use by mouth was preferred.

Nevertheless, if the chemical parts of the book are generally deserving of high praise, the non-chemical material is almost equally praiseworthy in many cases. Thus, on p. 235, it is good to see a figure demonstrating the liquefaction of agar. Many students gain the impression that agar is *never* liquefied by bacteria. As an undergraduate, the reviewer even had a professor of bacteriology who held to this view rather violently. The photograph of air-borne droplets produced in blowing the last drop from a pipette (p. 465) may help to explain many laboratory infections occurring in handling highly infectious bacteria.

Even if the strong emphasis on the chemistry of bacteria should limit the usefulness of the book as a text for students, it should make it invaluable as a reference work for practising bacteriologists and others.

WALTER C. TOBIE



DAIRY BACTERIOLOGY. *Third Edition.*

By Bernard W. Hammer. John Wiley & Sons, New York; Chapman & Hall, London. \$6.00. x + 593 pp.; ill. 1948.

Workers on the bacteriology of milk and milk products will find that the third edition of this standard text contains a wealth of valuable information on the microbiology of dairy products. It is to a considerable extent a compendium of the literature to about 1946. This is supplemented by a critical discussion of the claims of various workers, and by general observations by the author. Abundant attention is paid to the biochemical as well as to the bacteriological aspects of the subject. Each chapter is followed by a large number of references, which will be of great usefulness to those who wish to go to primary sources of information. The work is one of the very best in its field and is to be highly recommended.

A few lesser criticisms may be justified. On p. 244, some mention might perhaps have been made of the efficacy of penicillin in the treatment of mastitis.

Cysteine may inactivate penicillin (see p. 448), but cysteine would not ordinarily be called an enzyme.

WALTER C. TOBIE



PARASITOLOGY

TRICHOMONAS VAGINALIS AND TRICHOMONIASIS.

By Ray E. Trussell, with an introduction by E. D. Plass. Charles C. Thomas, Springfield. \$6.00. xii + 277 pp. + 1 plate; ill. 1947.

Trussell has rendered a valuable service to science by reviewing an extensive literature on the trichomonads of the human species. The bibliography of this monograph on the subject lists 1586 references which the author has apparently combed carefully for the essential information that has been included in this comprehensive compilation.

The author is excellently qualified to write a monograph of *Trichomonas vaginalis*, for it was he who first obtained a pure culture of this organism, thus initiating most of the fruitful recent discoveries concerned with its pathology and physiology. Working with able associates at the State University of Iowa, he has personally contributed much to our present knowledge of the growth requirements of the organism and the symptoms and treatment of vaginal trichomoniasis.

The book is divided into three major parts. The first, *Trichomonas vaginalis*, is devoted to the fundamental biology of this species and its relationships to other trichomonads. The second part, *Trichomonas vaginalis* Infections, presents the stricter medical phases of the subject. There are thorough discussions on the incidence of infection, methods of transmission, clinical symptoms, and laboratory diagnosis. Whereas formerly it was believed that transmission occurred mainly by inanimate objects, more recent information on the high incidence of the infection in men indicates a venereal transfer. The last portion of the book, on Treatment, is rather disheartening. The author reviews the various drugs and courses of treatment that have been tried, but concludes that there is no specific therapeutic agent which can at present be relied upon to cure latent and clinical infections of *Trichomonas vaginalis*.

It is fortunate that human trichomoniasis due to *Trichomonas vaginalis* is not as severe as the comparable disease in bovines. Nevertheless, due to its rather high nuisance value, this organism presents a challenge to the obstetrician, gynecologist, parasitologist, and those interested in preventive medicine. This excellent monograph will undoubtedly be a tremendous help to these scientists in their search for answers to the many unsolved problems.

The book possesses a detailed table of contents, an

index, many tables, several drawings and a number of photographs, two in full color.

M. M. BROOKE



HEALTH AND DISEASE

SCHOOL HEALTH AND HEALTH EDUCATION. *With Special Consideration of the Teachers' Part in the School Health Program.*

By C. E. Turner, with the Editorial Assistance of C. Morley Sellery. The C. V. Mosby Company, St. Louis. \$3.50. 457 pp.; ill. 1947.

The broadening concept of health as something more basic and more important than the mere absence of disease has brought an increasing demand for formal health education at all scholastic levels. With the increased importance of public interest and participation in community public health efforts, sound courses in health education in the public schools are entirely justified.

The present volume encompasses the latest thinking and the most successful programs and techniques in the field of health education at the public school level. Written primarily for teachers and school health personnel either in training or in service, the work covers every aspect of the subject of health education, from the development of the school health program through the mechanics of its implementation down to an evaluation of its effectiveness. Special emphasis is given to the training and duties of health educators and school health workers.

The volume is carefully planned, clearly written, and well documented with a topical bibliography of more than 100 articles and books. An index is provided.

B. AUBREY SCHNEIDER



MEDICINE TODAY. *The March of Medicine, 1946.* The New York Academy of Medicine. Columbia University Press, New York. \$2.00. xii + 177 pp. 1947.

In order to keep the general public abreast of the times and well informed on the progress of developments in the field of medicine, the New York Academy of Medicine sponsors an annual series of "Lectures to the Laity." The 1946 series, which comprises the present volume, was devoted to the social and economic aspects of medicine as related to the availability, cost, and distribution of medical care.

In the opening lecture, the development of organized medicine in the United States is summarized from the standpoint of the maintenance of high standards of medical training, practice, and research. The succeeding lectures cover such topics as the history of medical education, the evolution of the hospital and

clinical laboratory, the relationships of the general practitioner to the specialist in providing adequate medical care, and the impact of medical research and technical advancements on the health problems of the world.

Perhaps the most pertinent lectures for lay consumption are the last two of the series, which deal with the role of the enlightened layman in the fields of preventive medicine, and group hospital and medical care. The best public health program in the world, including all the recent advances in sanitation, immunology, and epidemic disease control, is of no avail unless the general public understands the importance and the necessity of such a program. An enlightened public can do much to assist the medical profession in its never-ending struggle with quacks, nostrums, and antivivisectionists. The history of inadequate distribution of medical services in the past is leading rapidly to some sort of organized and integrated system of community health services. If the public is to secure comprehensive medical care of high quality by group medical practice and insurance type prepayment, as much intelligent thought and action will be required on the part of the layman as on that of the physician.

This volume provides for the layman a well balanced picture of the practice of medicine today, as well as the role of the public in an equitable distribution of medical care. An index is provided.

B. AUBREY SCHNEIDER



THE BACKGROUND OF INFECTIOUS DISEASES IN MAN. *Lectures delivered in 1945 under the auspices of the Melbourne Permanent Postgraduate Committee and the New South Wales Postgraduate Committee in Medicine (University of Sydney).*

By F. M. Burnet. The Melbourne Permanent Postgraduate Committee, Melbourne, Australia. 7s. 6d. viii + 109 pp.; ill. 1946.

This little volume is the printed version of six lectures delivered in 1945. After an introductory lecture, the remaining five are devoted to: diphtheria, measles, rubella, and infectious jaundice; poliomyelitis; streptococcal infections with special reference to rheumatic fever; respiratory virus infections; and the natural history of tuberculosis. The material is presented in a sound and thoughtful fashion, but without much new material, except for some pertaining to Australian conditions.

Here and there the text makes mention of an author, sometimes with a date attached. The work would be of much greater value if adequate references to original publications had been given, to back up the statements made. Lecture audiences should not be bored with references, but in converting a series of scientific lectures into book form, references are almost essential

if the work is to be of more than passing interest. When such references are not given, the result is usually just another book, of little permanent value, to stand on the library shelves.

WALTER C. TOBIE



VETERINARY BACTERIOLOGY. Third Edition.

By Ival Arthur Merchant. *The Iowa State College Press, Ames.* \$7.00. viii + 683 pp.; ill. 1946. After having examined a considerable number of confused, illogical, and at times even ungrammatical contributions on various phases of veterinary medicine, it is refreshing to encounter the present well-presented text on veterinary bacteriology.

Part 1 covers the general biology of microorganisms; part 2, infection, resistance, and immunity; part 3, classification and characteristics of pathogenic bacteria, yeasts, and molds; part 4, the filterable viruses and bacteriophage. Pathogenic protozoa are not included, since it is considered that these important organisms are better handled under the subject of parasitology. Each chapter is followed by a useful bibliography, the references usually being to textbooks or monographs, but with some references to journal articles. It is regrettable that no definite reference seems to be given to Nowak in *Documenta Microbiologica*, a source from which many of the excellent photomicrographs of microorganisms have been taken. Errors seem to be few. The "Fordas" mentioned as an investigator (p. 291) should be "Fordos."

As an introductory text in veterinary bacteriology, the present work is distinctly superior. In fact, it is better than many of the introductory texts on medical or on general bacteriology. The reviewer cannot help wishing that such a clear-cut text had been available when he first studied bacteriology.

WALTER C. TOBIE



DIAGNOSTIC BACTERIOLOGY. A Textbook for the Isolation and Identification of Pathogenic Bacteria for Medical Bacteriology Laboratories. Third Edition.

By Isabelle Gilbert Schaub and M. Kathleen Foley. *The C. V. Mosby Company, St. Louis.* \$4.50. 532 pp. 1947.

This is the third edition of a laboratory manual which has definitely proved its value. It is essentially a book of laboratory procedures and is designed primarily for the inexperienced hospital laboratory worker and the interne. The procedures have been chosen on the basis of the authors' experience and are clearly presented in more or less outline form. Information of a practical nature which is not readily available in the

standard texts is given, as for example methods for separating bacteria when present in mixed culture. The value of culturing for anaerobic bacteria is stressed. These anaerobic organisms are often very significant clinically but are frequently overlooked or ignored because of inadequate mediums, methods, or awareness on the part of the laboratory worker.

With a few exceptions the content has been revised and brought up to date in the new edition. The most notable of the exceptions is the continued use of media made with infusion broth as a base. Peptones are now available which can replace, in most cases, the infusion. These peptones are constant in composition and promote much better growth of practically all bacteria. The fermented infusion broth used as a base for testing carbohydrate fermentation is very tedious to prepare and is not necessary.

The format of the book is the same as in the previous editions. The back of each page is left blank for notes. There is a good index.

E. PETRAN



APPLIED MEDICAL BACTERIOLOGY.

By Max S. Marshall, with the collaboration of Janet B. Gunnison, Alfred S. Lazarus, Elizabeth L. Morrison, and Marian C. Shevsky. *Lea and Febiger, Philadelphia.* \$4.50. 340 pp.; ill. 1947.

This book presents in a very concise manner much of the pertinent material on the subject which one has had to dig out of the larger, more detailed textbooks previously. The first part of the book deals with fundamental laboratory procedures, such as microscopy, sterilization and disinfection, washing glassware, preparation of culture media, the general technic of cultivation, isolation, and counting of bacteria, and tests of antibiotics. There is a good chapter on the use of laboratory animals and the diseases to which they are susceptible. Methods of handling, inoculation, bleeding, and autopsy are described. The general technics used in serology, virology, and mycology are given briefly. There is a short discussion of sanitary bacteriology. Particularly valuable is a chapter on biologic products. The kinds of biologic products available and a list of producers are given; this is information not usually readily available. Another important chapter deals with "specimens." The principles and methods of collection, information needed by the laboratory worker, and postal regulations governing the shipment of infectious materials are concisely presented.

The last half of the book is devoted to Diseases. There is first a general statement about each disease included, its etiology, occurrence, course, and whether or not immunization procedures are available and what methods are used in treatment. Then a statement of

what specimens to secure and why certain specimens are not of value in the particular disease under consideration. This is followed by a section on laboratory procedures and finally one on reporting. The diseases covered include those caused by bacteria, viruses, and fungi. At the end of the book are two tables. The first gives in summary form the diseases, organisms, specimens needed, animals to be used, and serological tests. The second lists the diseases and the culture medium used for isolation and differentiation of the causative organism. Finally there is a section giving the formulae of the common stains and solutions used in staining. There is an adequate index.

The laboratory procedures given are the usual ones found in standard texts. In some instances newer methods are now available. This volume would be more valuable if published in loose leaf form so that individual sections could be revised and kept up to date. The almost complete absence of references is surprising and would be a handicap to those wishing to get more detailed information on certain procedures. On the whole the book can be recommended to the teacher, student, public health worker, and laboratory worker as a source of pertinent information on the field of medical bacteriology.

E. PETRAN



THE UNCONQUERED PLAGUE. *A Popular Story of Gonorrhea.*

By Harry Wain. International Universities Press, New York City. \$1.50 (paper). viii + 119 pp.; ill. 1947.

This is a popular account of the activities of gonorrhea written with the view of telling the story of this disease in a straightforward manner, for the benefit of the interested layman. Ten chapters cover a description of the organism, its history, effects, means of transmission, and prophylaxis in a fashion that is neither medical nor moral, but which should make the book of great value to teachers and others who desire a readable account of this disease.

JOHN E. CUSHING



MOLECULES AGAINST MICROBES. *Sigma Introduction to Science Number 6.*

By E. S. Duthie. Sigma Books, London. 6s. 156 pp. + 8 plates + 5 charts; text ill. 1946.

An account, in popular style, of man's efforts to combat disease with chemical agents. The author assumes for the reader essentially no knowledge of chemistry or bacteriology and introduces the essentials of these sciences in conjunction with his story. He traces the development of chemotherapy from early to modern

times and gives a detailed and interesting account of this field, particularly regarding the discovery and development of the sulfonamides and the antibiotics. The book is an excellent one and covers its field so well that the student as well as the layman can learn much from it.

JOHN E. CUSHING



CHEMOTHERAPIE BAKTERIELLER INFEKTIONEN. *Beiträge zur Arzneimitteltherapie. Band I. Third Edition.*

By Gerhard Domagk and Carl Hegler. S. Hirzel, Leipzig; J. W. Edwards, Ann Arbor. \$10.00. xii + 446 pp. [1944] 1947.

This volume may be of use to students of the history of the development of sulfonamide therapy, but it appears to be of little value to the pharmacologist in 1948. The entire subject of sulfonamide chemotherapy has developed to such an overwhelming degree in the intervening years that the laboratory worker and teacher can scarcely afford to read a four-year-old text except for basic or historic material. The recent appearance of Northey's extensive monograph on this subject makes this all the more true.

The book is divided into two sections. Domagk has written the first part, which deals with the chemotherapy of bacterial infection from the viewpoint of the synthesis and pharmacology of the sulfonamide compounds. The text is replete with coined trade names for the various compounds, a fact that renders an intelligent grasp of the subject matter difficult. Recently-developed sulfonamides are not mentioned. There is, however, extensive consideration given to "Marfanil." The second part of the text has been written by Hegler and is concerned with the clinical aspects of treatment of bacterial infection with the sulfonamides.

The lithoprinting appears to be clear and sharp, but the reviewer found it difficult to read. The index is not complete and only very general terms are presented.

C. JELLEFF CARR



PULMONARY TUBERCULOSIS: *A Handbook for Students and Practitioners. Second Edition.*

By R. Y. Keers and B. G. Rigden, with a foreword by F. H. Young. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$5.00. xvi + 280 pp. + 122 plates. 1946.

In its clinical chapters, the new edition of this British handbook on pulmonary tuberculosis offers a concise and plainly authentic account of the diagnostic, therapeutic, and epidemiologic problems of the still largely unconquered disease. The authors may be

correct in stating that they can make no claim for any originality of method or material, but they are experienced clinicians and fully conversant with the medical and public health aspects of the disease. The illustrative material is well selected and technically far above the standards of a compendium.

The discussion of the constitutional features of tuberculosis is less satisfactory and often inconsistent. The significance of genetically determined variations in susceptibility and resistance to tuberculous infection is minimized and rather sketchily documented.

FRANZ J. KALLMANN



THE PAPWORTH FAMILIES: *A 25 Years Survey.*

By E. M. Brieger, with a preface by Sir Arthur Salusbury MacNalty. Grune & Stratton, New York. \$12.00. 674 pp. + 1 table; ill. 1946.

This sizable volume is the documentary success story of a humanitarian and mission-like experiment aiming at the coordinated conquest of the medical, social, and epidemiologic problems of tuberculosis. It covers the first 25 years of the thriving development of Papworth Village Settlement, that exemplary British community for employable tuberculous patients which grew from the smallest beginnings to a prosperous colony of 142 cottages and hostels housing the families of cured staff members and married ex-patients with a total of 368 children (about one-third of them born in the village). The book is a noble document in the history of tuberculosis prevention and, regardless of certain basic shortcomings, a glowing tribute to the pioneer work of the author's predecessor and philanthropic founder of the settlement, the late Sir Pendrill Varrier-Jones.

One of the main objectives of the colony has been to raise a "tuberculosis free herd" by providing adequate housing and food supplies, freedom from anxiety by means of assured employment and liberal education, and the potential benefits of an active social life without bias and strenuous competition. The author's faith in the creditable goals of the settlement is expressed in the proud statement that "the children born in Papworth village have not shown any symptoms of either active extra-pulmonary or pulmonary tuberculosis, and no death from tuberculosis has been recorded." The obvious merits of the experiment may be seen in the demonstration of the controllability of the spread of tuberculous infection under most favorable and intelligently supervised environmental conditions.

The weakness of the author's eutheic optimism reveals itself in the utterly uncritical tendency to promote the undisputed usefulness of one curative or "herd-raising" principle by depreciating that of any other. His claim that "there is no need for the supposition of a hereditary predisposition" is based on wishful generalizations rather than scientific facts.

The author does not seem to realize that tuberculosis control in a modern world cannot be accomplished entirely through mass segregation of affected families under rural glasshouse conditions.

FRANZ J. KALLMANN



ENDOCRINOLOGY OF NEOPLASTIC DISEASES. *A Symposium by Eighteen Authors. Oxford Medical Publications.*

Edited by Gray H. Twombly and George T. Pack. Oxford University Press, New York. \$11.00. vi + 392 pp.; ill. 1947.

This is a collection of excellent review articles covering the entire field of the relationship of the endocrines to cancer. The endocrine effects of hormone-producing tumors are treated with the same thoroughness as the relationship of hormones to cancers of the breast and the prostate. I. T. Nathanson presents the relationship of the steroid hormones to cancer of the breast in a masterly fashion. J. H. Farrow gives an excellent account of the effect of sex hormones on skeletal metastases from breast cancer. This article is based on the author's clinical experience at the Memorial Hospital for Cancer in New York City. It is of great interest that estrogens and androgens have a similar effect on skeletal metastases from mammary cancer. However, retardation of malignant growth brought about by administration of these steroid hormones is inconstant and of a temporary nature. This is also true for the treatment of carcinoma of the prostate by castration and administration of estrogens. Moore, Dean, Woodard and Twombly have written two superb chapters on this subject.

The study of adrenal cortical tumors has led to a number of significant physiological observations and theories. A. T. Kenyon has written a review, both lucid and comprehensive, of this field.

Considering the wealth of information in every chapter of this fascinating symposium, it cannot be too strongly recommended.

WALTER FLEISCHMANN



THE PATHOLOGY OF NUTRITIONAL DISEASE. *Physiological and Morphological Changes Which Result from Deficiencies of the Essential Elements, Amino Acids, Vitamins, and Fatty Acids.*

By Richard H. Follis, Jr. Charles C. Thomas, Springfield, Illinois; Blackwell Scientific Publications, Oxford; The Ryerson Press, Toronto. \$6.75. xii + 291 pp.; ill. 1948.

This book describes the physiological and morphological changes which result from deficiencies of the fourteen essential inorganic elements, the ten essential amino acids, the fifteen best known vitamins, and the essential

fatty acids. The concluding section, entitled "The pathologic anatomy of specific tissues—a recapitulation and comparison," deals with epithelial tissues, mesenchymal tissues, blood-forming tissues, vessels and the coagulation mechanism, muscle tissues, and nervous tissues. The author has devoted much time to the study of several of the deficiency states and is a well known investigator in this field.

The science of nutrition was developed principally by biochemists. Many important discoveries of hitherto unsuspected nutrients were made before pathologists made very significant contributions to our knowledge of what happens when body chemistry is perverted by inadequate supply, or total deprivation, of single indispensable nutrient chemical substances. Biochemists who made fundamental discoveries about foods and nutrition were generally unable to comprehend the meaning of symptoms of nutritive failure from specific causes. For this reason the writings relating to malnutrition contain much that is faulty in observation and interpretation. After the pioneering studies of Wolbach and his associates, several pathologists have devoted their efforts to the study of deficiency states with great success. Critical readers will see throughout the book evidence that the author has made a careful study of almost all of the scientific papers which contribute to an understanding of his subject. Evidence of keen insight and clear interpretation are to be found on every page. The book will be appreciated by everyone interested in biology, biochemistry, physiology, and medicine as well as to pathologists.

E. V. MCCOLLUM



ALLERGY. *Second Edition.*

By Erich Urbach and Philip M. Gottlieb. Grune & Stratton, New York. \$15.00. xx + 968 pp.; ill. 1946.

The second edition of *Allergy* by Urbach and Gottlieb differs from the first edition in that thirteen hundred references have been added. The publisher's advertisement states that this addition indicates "the vast amount of recent clinical and laboratory findings correlated and evaluated in this standard work on allergy." The book is encyclopedic in type. Abstracts of all of the references which have been mentioned as the reason for a second edition have been incorporated in the body of the text. Good and poor investigations are referred to, but little attempt has been made to separate the chaff from the grain. The reviewer has not attempted to read this volume in detail. As a reference book it can be recommended because the entire field of hypersensitivity and allergy has been summarized. Methods of treatment are recorded and numerous references are cited to support

the many therapeutic measures. If the inexperienced physician reads the book, I am sure he will be confused. The discriminating reader might find it of assistance if a library is not available.

LESLIE N. GAY



L'HYPERINSULINIE. *Les États de Suractivité Fonctionnelle du Pancréas Endocrine en Médecine Expérimentale et en Clinique.*

By Marcel Sendrail. Masson et Cie., Paris. 500 fr. (paper). iv + 256 pp. + 2 plates; text ill. 1947.

In reviewing the literature, largely American, on hyperinsulinism attributable to a tumor of the islets of Langerhans it appeared to the author that the problem "exceeded the bounds set by simple langerhansian tumors." "It is a biological problem, with multiple experimental, cytological, symptomatic, and therapeutic ramifications, whose liaison with problems connected with endocrinology demands ample exposition, and merits a synthetic study which has not yet been accorded it." This has now been adequately achieved by the author; and several sections, well documented from European and American sources, treat every phase of hypoglycaemia and hyperinsulinism. Probably of greatest interest to readers of the Quarterly is the chapter on experimental hyperinsulinism. The author, incidentally, introduced the insulin tolerance test into routine clinical medicine in 1928. There is an "analytical table of contents" in the French manner, and chapter bibliographies, but no general index.

H. R. CATCHPOLE



METHODS FOR LABORATORY TECHNICIANS. *War Department Technical Manual TM 8-227.*

U. S. Government Printing Office, Washington, D. C. Paper. v + 618 pp.; ill. 1946.

This manual might have been better called "Laboratory Methods for Army Medical Laboratory Technicians." It is a revision of the previous issue which was hurriedly compiled and published under "emergency" conditions in 1941. It has been expanded from 447 pp. to 618 pp.; and presents a large amount of condensed and useful information on working methods in bacteriology, parasitology, hematology, clinical biochemistry, and related topics. It should be of value in civilian as well as in military medical laboratories.

Although the manual should be very useful to army medical laboratory officers, some of the material will probably be exceedingly heavy going for the average army medical technician. A number of the methods have been greatly over-elaborated by specialists who have shown but little regard for average army working

conditions. Thus, a very complicated and precise method for determining cholesterol in blood is given, covering 9 pages of text and employing 11 different reagents. The blood cholesterol method of 1941, which occupied only 1 page of text and used only 4 reagents, was probably far more practical for ordinary clinical use.

It is doubtful whether some of the more complicated procedures will ever be *widely* used in army clinical laboratories. In most cases they are likely to remain only a theoretical "on paper" dream. Simpler methods, adapted from other sources, will be much more commonly used, or else the determinations will not be done at all.

Under these conditions, it is difficult to decide whether it is fortunate or unfortunate that this revision was delayed so long. Back in 1942 and 1943, the reviewer had some contact with this manual. At that time the work of revision was a sort of football, kicked about from one office of the Army Medical Department to another. No one seemed to have the authority to make the final decision as to what should or should not be included. This may account for the fact that this revision was not published in time to be used in World War II.

WALTER C. TOBIE



THE TREATMENT OF DRUG ADDICTS. *Bulletin of the Health Organization, Volume XII, Number 4.*

By P. O. Wolff. League of Nations, Geneva; Columbia University Press, International Documents Service, New York. \$1.25 (paper). 229 pp. 1945-46.

This excellent survey, based on more than twenty years of personal international experience in the field, deals primarily with treatment of addiction to morphine and the great number of other opiates. Cocaine and marihuana, which apparently produce less profound metabolic changes, and therefore fewer physiological problems in treatment, are discussed less extensively. The author reports on all forms of withdrawal treatment, although his own inclination is unmistakably toward sudden withdrawal in closed institutions. Auxiliary treatments by narcotic drugs, proteins, endocrine preparations, lipids, diuretics, etc. are described in detail. Psychotherapy and after-treatment are given due attention. The author favors usually methods of treatment as developed in this country by Himmelsbach, Kolb, etc. Yet in reporting additional experiences and opinions of French, English, German, South American, Indian, Chinese, etc. workers he provides a most valuable source of otherwise little accessible information and stimulation to North Americans interested in the field. A fine bibliography of 477 numbers allows the following up of special problems like congenital addiction (babies of addict-mothers). This

volume is a most valuable tool in tackling one of the most disturbing problems in contemporary therapeutics.

ERWIN H. ACKERKNECHT



PSYCHOLOGY AND ANIMAL BEHAVIOR

THE PSYCHOLOGY OF HUMAN DIFFERENCES. *The Century Psychology Series.*

By Leona E. Tyler. D. Appleton-Century Company, New York and London. \$3.75. xiv + 420 pp.; ill. 1947.

Much of the content of psychology is concerned with the description and analysis of average human behavior. This is as it should be, since one of the main functions of the science of psychology is to provide useful generalizations about the way people as a whole learn, think, and act. There is, however, another large group of generalizations in psychology which describe the ways in which people differ from the average. This body of knowledge is usually taught in courses labelled Individual Differences, Differential Psychology, or Human Variability. Tyler's book is suitable as a text for undergraduate courses of this nature.

The book is divided into four major sections. Part I is introductory, being largely concerned with a survey of the ways in which human characteristics vary. Part II deals with the major group differences: sex, race, nationality, class, and age differences. There are also in this section two special chapters, one on the feeble-minded and the other on the genius. Part III discusses factors related to individual differences: the relationship of mental to physical characteristics, the effects of practice, and the contributions of hereditary and environmental factors to individual differences. Part IV is concerned with the appraisal of the individual. It contains two chapters on the measurement of aptitudes and the search for basic traits.

The field of individual differences means different things to different people. The contents of this book, however, will probably satisfy most psychologists. Especially noteworthy, in the reviewer's opinion, is the inclusion of a chapter on age differences and another on the effects of practice and training on individual differences. Differences in age contribute more to the total variability of certain kinds of human abilities than do race, sex, or class differences. Yet age as a factor contributing to individual differences is very often ignored. The effects of practice on individual differences have also been largely neglected, although the results of research in this area have broad implications for psychology and education.

Tyler's style of writing deserves special mention because it is so clear. As an illustration, she has been able to write about unusually complex statistical techniques, e.g., factor analysis, in a way that should leave

the undergraduate student with some appreciation of what these techniques do. This in itself is a commendable achievement. Although she has by no means summarized all the literature in the field of individual differences, her interpretation of research findings is sound and thought-provoking. All in all, this should be a stimulating book for students in psychology, education, the social sciences, and related fields.

A. CHAPANIS



LA PSICOLOGIA SPERIMENTALE DI SANTE DE SANCTIS.
By Romolo Appicciafuoco, with preface by Ferruccio Banissoni. Casa Editrice Orsa Maggiore, Roma. L.250 (paper). 292 pp. 1946.



PSYCHOLOGICAL ATLAS.

By David Katz. *Philosophical Library*, New York. \$5.00. x + 142 pp.; ill. 1948.

This is a collection of charts, diagrams, and pictures published with the intention of "arousing a zeal for the study of psychology." The materials are those which Katz has used to illustrate his lectures. They are certain to impress the reader with the author's versatility, but whether they will serve to create any interest in psychology in this country is not so certain. The descriptions accompanying the illustrations are extremely brief. Only 36 of the figures are from sources written in English. Something of the range of interests covered will be apparent from considering the first and last pictures of some of the major divisions of the book. Under General Psychology appear 105 figures, the first of which is a view of the human brain, and the last the Chinese ideograms for psychology. Under Character and Topology are 56 illustrations, the first showing the muscles of the face, and the last the Szondi test. Developmental Psychology (74 illustrations) starts with the change in relative proportions of the human body from infancy to 25 years, and ends with a drawing of a child's imagined spatial relations of the days of the week. The 24 figures under Physical Handicaps start with deaf-mutes around a piano learning to recognize rhythms and end with foot-writing by an armless boy. The first figure of the 36 under Medical Psychology shows an apparatus for teaching percussion to medical students, and the last shows figurines made by natives of the French Congo and by a schizophrenic patient. Eleven pictures appear under Occult Phenomena, starting with a divining rod and ending with "a diagram representing an occult philosophy of the significance of bodily proportions." The sections on Applied and Animal Psychology, with 21 and 26 illustrations respectively, reveal the same catholicity of interests. The final 41 figures are photographs of Eminent Psycholo-

gists. As P. L. Harriman states in the Foreword, this atlas will "furnish material for many a pleasant and stimulating hour." The title page states that there are 400 illustrations, the dust cover says 396, and the reviewer was able to find 394.

R. B. BROMILEY



HANDBOOK OF GENERAL PSYCHOLOGY. *A Summary of Essentials and a Dictionary of Terms.*

By W. B. Pillsbury and L. A. Pennington. The Dryden Press, New York. \$1.75. xiv + 400 pp.; ill. [1942]; 1946.

According to the authors, "the purpose of this volume is twofold. First, the subject matter of general psychology has been summarized for the convenience of the general reader who wishes to understand the behavior of the normal adult individual.... Second, the book has been arranged to serve as a guide for the college student who studies psychology for the first time."

Upon inspection, this book turns out to be a condensed elementary psychology—midway between a textbook and an outline such as one might find in the *Student Outline Series*. Although there are 400 pages in the book, the pages are small, and only 294 of them are devoted to the Summary of Essentials. (Actually, another 45 pages must be subtracted for the test questions and references which follow each chapter.) There is nothing inherently wrong with brevity, of course, and a condensed handbook of elementary psychology could be very useful if it were well written. This one is not. It is full of declarative statements which, on the whole, are terribly dull. In addition, the authors have studded the text with asterisks to indicate words which are defined in the Dictionary of Terms (Part II of the book). Perhaps these actually do assist the reader. The reviewer, however, found them extremely distracting.

The dictionary of terms mentioned above occupies 70 pages. It contains a few definitions which are clearly incorrect (e.g., "Deuteranopia: A type of partial color-blindness in which the green is perceived as darker than the red"), a few which are partially correct, and a fair number which are so vague as to be of questionable value (e.g., "Dark adaptation: The increased sensitivity of the eye to light"; "Co-twin control: Same as training method").

This is probably the kind of book which would be of use to a poor student who needed to memorize a series of facts and definitions in their barest essentials so that he could pass a final examination. The discriminating reader who wants to know about psychology is advised to look elsewhere.

A. CHAPANIS

FURTHER EFFECTS OF ADDED THIAMIN ON LEARNING AND OTHER PROCESSES. *Teachers College, Columbia University, Contributions to Education, No. 928.*

By Ruth Flinn Harrell. Bureau of Publications, Teachers College, Columbia University, New York. \$2.75. viii + 102 pp. + 4 plates; text ill. 1947.

This monograph is a report of original research, extending the author's earlier work on the effects of thiamin supplementation on learning and intelligence. One hundred and twenty children, four to eighteen years of age, were studied at the Presbyterian Orphan's Home at Lynchburg, Virginia, over a two-year period. At the start of the experiment, the children were paired on the basis of age, sex, size, education, and family of origin. In the first year, one member of each pair was fed two mg. of thiamin in tablet form each night at bedtime. The control member of each pair received a placebo indistinguishable from the thiamin tablet. Careful controls were accomplished with a coding system such that neither the children, the adults administering the tablets, nor the test administrators knew which children were receiving the supplementary thiamin. At the end of one year, the experiment was suspended for 60 days during which time no tablets were administered. Then each group was divided in two. One half was continued on the same treatment for a second year; the other half of each group received the reverse treatment, i.e., they were shifted from thiamin to placebo and vice versa.

A battery of tests was administered by experienced personnel at intervals throughout the experimental period. The CAVD and Kuhlmann-Anderson Tests of intelligence, the Snellen and Telebinocular Tests of visual acuity, a choice-reaction timing test, and the Metropolitan Achievement Test (educational achievement) were given at the start of the program in September 1942, nine months later in June 1943, and seven months after the resumption of tablet administration in the second year, in June 1944. In addition, measures of memorization and retention, code substitution, height and weight, and the incidence of colds were taken at more frequent intervals.

The over-all design of this experiment was excellent, but the author's conclusion, at the end of the work, that the thiamin-fed children showed greater gains in every test of ability must be critically evaluated. Although it is true that the children of the thiamin group made greater average gains in each measure, it is by no means clear that these gains are attributable to thiamin supplementation alone. In the first place, in almost every test used, the thiamin-fed children were inferior to the controls in the initial testing. Since the tests used are not of the highest reliability, it might well be expected, in terms of statistical regression alone, that the thiamin-fed children would show greater gains. In the second place, as the author's statistical analysis of the results indicates, not all the greater gains of the

thiamin group are statistically significant. That is to say, some of the differences may be attributable to chance alone (viz., the difference in gains in the Kuhlmann-Anderson Test of intelligence, one of the visual acuity measures, the educational achievement test, and weight). In fact, only seven of the 15 measures taken showed greater gains of the thiamin group that were significant at the one per cent level of confidence or better, viz., four of the visual acuity measures, the code substitution test, one retention test, and the memorization test. In the other measures, the differences were between the one and five per cent levels of confidence.

An extreme example of the dangers inherent in drawing conclusions from this statistical treatment of the data may illustrate the need for caution in interpreting these results. In the measures of visual acuity made with the Telebinocular Test, it was found that the greater gain in the left eyes of the thiamin-fed children was such that it could be expected by chance alone only twice in a million times, while the difference in the gains in the right eye could have occurred by chance alone as often as one time in ten. Statistically, this is the most significant result of the whole experiment; practically, it is not. It makes no physiological sense and seems to be only a reflection of the unreliability of the test used.

Further caution is needed in generalizing from the results obtained with this selected group of children. In the first place, as the author points out, the orphanage diet was not well-balanced. Although it contained more than adequate quantities of milk, it was low on eggs and meat. Furthermore, the vegetables were routinely overcooked, and efforts were made to prevent the use of enriched flour in the preparation of food. Secondly, the average intelligence quotient of the children used in the study was about 91 (Kuhlmann-Anderson), which means that the group was on the low side of average intelligence.

This study represents an important experimental beginning in the investigation of the problem of nutritional and biochemical factors in learning, intelligence, and other complex behavioral capacities. It cannot be urged too strongly, however, that its results and conclusions are to be viewed with great reserve, until it is sufficiently clear which of them can be verified and which are experimental artifacts.

ELIOT STELLAR



DEVELOPING YOUR CHILD'S PERSONALITY.

By Gelolo McHugh. D. Appleton-Century Company, New York and London. \$2.75. xii + 234 pp. 1947.

This is a pleasant but unimportant book along usual lines. Preparations for parenthood, fundamentals of child care, eating habits, toilet training, thumb-sucking,

sex education, speech development, social development, and the dilemma of the next child are dealt with conscientiously. There is no quarrel with McHugh's thinking on these subjects. Indeed, it would be a harmless book (and as such possibly even reassuring) to give to a young wife or mother. The main criticism to be made is that in the author's effort to be casual and matter of fact about the whole thing, he has employed a glib, unemphatic style which leaves the reader rested but wondering if anything was actually said.

HELEN HEWITT ARTHUR



NON-PROJECTIVE PERSONALITY TESTS. *Annals of The New York Academy of Sciences, Volume XLVI, Article 7.*

By Harold A. Abramson, Kever Brodman, Harold J. Harris, George G. Killinger, Bela Mittelman, Zygmunt A. Piotrowski, David Rapaport, Roy Schafer, Martin Scheerer, David Wechsler, Arthur Weider, Harold G. Wolff, Edith Wladkowsky, and Joseph Zubin. *The New York Academy of Sciences, New York.* \$1.75 (paper). Pp. 531-678. 1946.



THE IMPACT OF A CHILDREN'S STORY ON MOTHERS AND CHILDREN. *Monographs of the Society for Research in Child Development, Volume XI, Serial Number 42, Number 1, 1946.*

By Martha Wolfenstein. *Society for Research in Child Development, National Research Council, Washington, D. C.* \$1.50 (paper). iv + 54 pp. 1947.

This is a well-written report on a very interesting and original (if not very elaborate) piece of research in the field of child development. A panel of child psychologists outlined the ingredients for a child's story centered around the provocative elements in a youngster's reaction to the anticipation and actual arrival of a sibling. A professional writer assembled an ingenious tale entitled "Sally and the Baby and the Rampatan" to fit the specifications. Then this story was submitted to a group of ten educated mothers to read to their respective four year olds. The children's subsequent reactions to the story were noted in their play activities and in the group on a rereading of the story by the teacher. The mothers' reactions to the story were solicited and correlated with the individual child's response. Upon evaluating the material thus acquired, it became clear that each mother colored the story with her own unconscious reactions to the provocative situation depicted and transmitted attitudes to her listening child which markedly affected his response to the tale. Case histories included in this monograph are particularly interesting. While this study was carried out on a statistically insignificant group, the dynamic viewpoint of the report makes the findings well worth exam-

ining. More studies of this calibre and using the medium of the child's story should be forthcoming.

HELEN HEWITT ARTHUR



LEARNING TO USE HEARING AIDS: *A Study of Factors Influencing the Decision of Children to Wear Hearing Aids. Report of the Subcommittee of the Committee on Problems of Deafness of the National Research Council.*

By Arthur I. Gates and Rose E. Kushner. *Bureau of Publications, Teachers College, Columbia University, New York.* Free upon request (paper). iv + 77 pp. 1946.

This is a report of a study made on 38 children who needed and were given hearing aids. It was found that the children who adapted themselves to using the hearing aid were the better adjusted, more intelligent children to begin with. Insecure, less adequate youngsters discarded the hearing aid for reasons of embarrassment or inability to handle the aid successfully. The authors suggest a number of ways in which all children needing such aids might be persuaded to accept them more readily and with less emotional resistance.

HELEN HEWITT ARTHUR



MAN FOR HIMSELF. *An Inquiry into the Psychology of Ethics.*

By Erich Fromm. *Rinehart and Company, New York, Toronto.* \$3.00. xiv + 254 pp. 1947.

In this very scholarly volume, Erich Fromm presents a philosophical study of moral and ethical standards based on "rational value judgments." These rational value judgments of human nature and human needs are made possible by the insight of modern psychology—to which we are so indebted to Freud. But the development of associated ethical goals is an original and highly important contribution to the science of psychiatry, which has always been accused of breaking with accepted moral standards without providing alternative values. Psychiatrists and a great many others who work with people or who are philosophers groping for a solution to our modern moral muddle will be indebted to Fromm for his convincing and encouraging thesis that there are constructive, emotionally healthy, ethical standards which every mature individual must accept and live by.

The author begins his book, appropriately, by developing the case for humanistic ethics—a standard of constructive values based on the knowledge of man and not on some preconceived idea of what man should be. The basic principle of this philosophy is that "virtue is the same as man's pursuit of obligations toward himself and vice the same as self-mutilation." Following this discussion, Fromm extends his carefully worded buildup to give an incisive, dynamic description of character.

He divides his concept of "dynamic character" into two orientations—the non-productive and the productive. Within the non-productive frame are the neurotic, mentally unhealthy character types. Next, in logical sequence, Fromm attacks directly the problem of resolving the conventional (or authoritarian) ideas of morality with the morality of the humanistic philosophy. Questions of selfishness, conscience, pleasure, faith, good and evil are taken up with the same deeply philosophical yet pragmatic approach which makes the reader feel as if he were finding answers for himself.

Man for Himself is not an easy book to read. It is too fundamental to be facile. However, it is an enriching experience emotionally and intellectually, to have followed the author's beautifully clear, scholarly thinking from premise to conclusion.

HELEN HEWITT ARTHUR



MENTAL HYGIENE. *Sixth Edition.*

By J. Lowrey Fendrich, Jr. *Willing Publishing Company, Los Angeles.* \$1.00 (paper). 76 pp. 1947.

THE PSYCHOLOGY OF CHILDHOOD.

By Evelyn Whitell. *Willing Publishing Company, Los Angeles.* \$1.00 (paper). 73 pp. 1947.

These are two highly moral little tracts written by non-professional people for an unspecified but certainly a very naive audience. The booklet on *Mental Hygiene* reads like a vigorous sermon in which the reader is exhorted, among other things, to "live one day at a time," "to think positively," and in general to seek peace and power from God.

The pamphlet with the resounding and misleading title of *The Psychology of Childhood* is a series of completely unscientific, sentimental little notes on children, from prenatal days onward. For example, the expectant mother is adjured to repeat "Mother's Song" hourly for its salutary effect on her foetus. Much space is devoted to the need for prayer and uplift involving family and children alike.

Although unrealistic, unoriginal, and uninteresting, neither pamphlet contains any vicious untruth. Most deceiving are the ambitious titles, which represent a transparent attempt to capitalize on the modern interest in mental health as a wedge for moralistic religious propagandizing.

HELEN HEWITT ARTHUR



PSYCHIATRY FOR EVERYMAN.

By J. A. C. Brown. *Philosophical Library, New York.* \$3.00. viii + 247 pp. 1947.

This book succeeds in giving a first-rate account of the development of psychiatry in simple terms which are

easily understandable. Brown has discussed various ideologies within the psychiatric field and its outstanding symptom states. He succeeds in demonstrating that "mind is not a thing but a process; not a noun but a verb." The book can be recommended for general use.

WENDELL MUNCIE



PSYCHOPATHOLOGY. *A Survey of Modern Approaches. Fourth Edition.*

By J. Ernest Nicole. *A William Wood Book, The Williams & Wilkins Company, Baltimore.* \$4.75. viii + 268 pp. 1946.

The fourth edition of Nicole's well-known work brings the survey of the field up to date with an extensive bibliography. This is an excellent guide to modern trends in psychopathology. It includes a good historical background and extensive statements of each of the principal contributions to modern eclecticism: Freud's psychoanalysis; Adler's individual psychology; Jung's analytical psychology; the theories of T. S. Rivers; Watson's behaviorism; Kempf's contributions; the endocrine, biochemical, and other physiological and anatomical considerations; Kretschmer's constitutional studies; ethnological and sociological evidence; modern schools of psychology—Gestalt, Hormic, and so on. This most useful text will repay study by any one interested in the many trends in present day psychopathology.

WENDELL MUNCIE



INTRODUCTION TO MEDICAL PSYCHOLOGY.

By L. Erwin Weisberg. *Grune & Stratton, New York.* \$3.50. x + 171 pp. 1947.

This little book is the outgrowth of lectures which the author gave during the seven years he taught undergraduates at Louisiana State University School of Medicine. The chapter headings will indicate the scope of the book: Individual and Community, Knowledge and Action, Emotions and Instincts, Temperament, Personality, and Character, Genetic Psychology, Methods and Technics of Clinical Psychology. This material is well presented, the book is quite readable, and could well be used in introductory courses in medical psychology.

WENDELL MUNCIE



HYPNOTHERAPY. *A Survey of the Literature. The Menninger Foundation Monograph Series Number 5.*

By Margaret Brenman and Merton M. Gill. *International Universities Press, New York.* \$4.50. xii + 276 pp. 1947.

This volume is composed of three distinct and somewhat divergent parts. The first and most important section of the book is a comprehensive, intelligently organized integration of modern thought on the different aspects of hypnotherapy. After a brief chapter on the historical development of hypnotherapy, the authors devote a chapter to Methods of Inducing and Terminating Hypnosis. Procedures for "sleeping methods," drug hypnosis, "Hypnoidization" (a sort of pre-hypnotic relaxation), and "waking methods" are described carefully, often in direct quotations from the original investigators. It is a most helpful presentation and clarifies immediately much of the hocus-pocus that surrounds the hypnotizing process in the minds of those who have not tried to do it. The next chapter, entitled Susceptibility to Hypnosis, considers what factors are required for a good hypnotic reaction and what suggestions have been made to improve a subject's response. The fourth chapter is perhaps the most fascinating to a clinician, in that here the therapeutic applications of hypnosis are presented. Both authors are fully experienced in the use of the hypnotic technique and, although their purpose here is to make a survey of what has been done along these lines, they deal with the subject in an authoritative way, contributing creative details of their own experience to lend credence and life to the whole discussion. Chapter five is on The Theory of Hypnosis. Here a variety of points of view is presented, but no definite conclusions have been reached. The survey is summarized in chapter six, and future problems needing investigation are pointed up. All in all, this section of the book is excellent and will be a stimulating and practical reference text for professional people interested either in psychiatric research or therapy.

Section II is comprised of four case histories of patients treated by hypnotherapy. They make fascinating reading and certainly present evidence in favor of the therapeutic method under consideration. However, the cases, chosen exclusively from the authors' own professional circle, tend to dispel the generous effect of section I. Here the "survey" has narrowed down to reporting very special and highly personalized work rather than reporting on a more general sampling of therapeutic work in the field. The tacit implication seems to be that the home of modern dynamic hypnotherapy is in Topeka. Maybe it is.

The third part of the volume is a tedious tour de force by Margaret Brenman to illustrate the use of hypnotic techniques in a research project. The study was originally submitted as her doctorate thesis and, even though considerably condensed here, is still dull reading. It should be granted that she makes a point, but it seems to contribute very little to the stature of the book as a whole.

HELEN HEWITT ARTHUR

CONCEPTIONS OF MODERN PSYCHIATRY. *The First William Alanson White Memorial Lectures. Psychiatry: Journal of the Biology and Pathology of Interpersonal Relations, Volume Three, Number One, February 1940 and Volume Eight, Number Two, May 1945.*

By Harry Stack Sullivan, with a Critical Appraisal of the Theory, by Patrick Mullahy. The William Alanson White Psychiatric Foundation, Washington, D. C. \$2.00. viii + 147 pp. 1945.

This is the second printing of Sullivan's first William Alanson White Memorial Lectures, and constitutes an excellent statement of the author's views concerning personality structure and its study as the study of the "relatively enduring pattern of recurrent interpersonal situations which characterize a human life." It furnishes an important statement of the Washington Psychoanalytic Institute's basic principles. There are some critical notes appended by Patrick Mullahy.

WENDELL MUNCIE



FREUD: ON WAR, SEX AND NEUROSIS.

Edited by Sander Katz; translated by Joan Riviere, Alix and James Strachey, R. C. McWatters, E. B. Herford and E. Colburn Mayne, with glossary and preface by Paul Goodman. Arts and Sciences Press, New York. \$3.00. 288 pp. 1947.

This varied collection of out-of-print papers by Freud ranges chronologically from the classic study of "Dora: an Analysis of a Case of Hysteria" (1905) to "The Taboo of Virginity" (1918), thus covering the "heroic" period of psychoanalysis. In this middle period of his career, beginning with the use of dreams for therapeutic ends in the case of Dora, Freud had already established his novel concepts of "neurasthenia" and the importance of sex and was engaged in the application of his psychoanalytic technique and theory. Not only the new cases in his clinical practice, but anthropological data and common social experience entered the ambit of his thought.

In addition to the essays already named, the selection includes the following: One of the Difficulties of Psychoanalysis (1917); Obsessive Acts and Religious Practices (1907); The Sexual Enlightenment of Children (1907); "Civilized" Sexual Morality and Modern Nervousness (1908); Contributions to the Psychology of Love: A Special Type of Choice of Object Made by Men (1910), and The Most Prevalent Form of Degradation in Erotic Life (1912); Thoughts for the Times on War and Death (1917). For all readers of Freud, this volume is a welcome addition to the available literature.

BENTLEY GLASS



THE WORLD WITHIN. *Fiction Illuminating Neuroses of Our Time.*

Edited by Mary Louise Aswell, with an introduction and analyses by Frederic Wertham. Whittlesey House, McGraw-Hill Book Company, New York and London. \$3.75. xxviii + 376 pp. 1947.

This volume contains material from past and current literature dealing with psychopathologic states (not all strictly neurotic), with introductory statements by Mary L. Aswell, and analyses by Wertham. Dostoevsky, Chekov, Proust, Kafka, E. B. White, Faulkner, Robert M. Coates, and others are represented. The relationship between belles-letttrist intention and unconscious psychopathologic processes is shown.

WENDELL MUNCIE



THE MIND IN ACTION.

By Eric Berne. Simon and Schuster, New York. \$3.00. xxii + 320 pp. 1947.

This is an excellent statement which begins with objective facts about man and ends with dynamic psychology of the Freudian variety. It can be recommended highly for the audience to which it is directed.

WENDELL MUNCIE



PRACTICAL PSYCHIATRY. *Between Mental Health and Mental Disease.*

By B. Liber. Melior Books, New York. \$3.50. xiv + 412 pp. 1947.

This book, hailed as epoch-making by its publishers, falls far short of the mark. It is so full of biased or arguable statements made in a dogmatic fashion that a critical reader tends to suspect the entirety. This is unfortunate, for there are some kernels of wisdom in it. Let the reader make his own choice!

WENDELL MUNCIE



PRACTICAL CLINICAL PSYCHIATRY. *Sixth Edition.*

By Edward A. Strecker, Franklin G. Ebaugh, Jack R. Ewalt, and the section on Psychopathologic Problems of Childhood by Leo Kanner. The Blakiston Company, Philadelphia and Toronto. \$5.00. xii + 476 pp. + 1 chart; ill. 1947.

This sixth edition of Strecker and Ebaugh's popular textbook includes Jack Ewalt as associate author. The material of this textbook is now so well known as not to require any special statement. It has gone through more editions than any other textbook in psychiatry, and is widely used. The book follows the psychobiological principles of Adolph Meyer, is replete with condensed case histories, and the suggestions for treatment are well given.

WENDELL MUNCIE

SYNOPSIS OF NEUROPSYCHIATRY. *Second Edition.*

By Lowell S. Selling. The C. V. Mosby Company, St. Louis. \$6.50. 561 pp. + 1 plate; ill. 1947.

If there is any reason for a synopsis at all, this is good enough. There are a great many things throughout the text of value and some things about which one might be quite critical. Of the latter, one may point out, as difficult to understand or accept, what Selling calls "parapsychoses." I am unable to identify these patients from the brief descriptions he gives. His recommendation for extensive electro-shock therapy followed by psychotherapy is quite a shock to this reviewer. On the whole, there seems to be less to criticize in those chapters which have to do with neurology rather than psychiatry. The book could be of some use for a quick review of material for the Board Examinations.

WENDELL MUNCIE



INTRODUCTION TO PSYCHOBIOLOGY AND PSYCHIATRY. *Second Edition.*

By Esther Loring Richards. The C. V. Mosby Company, St. Louis. \$3.75. 419 pp. 1946.

This second edition of Esther Richards' popular book for nurses contains a considerable appendix on therapeutic methods and on special psychological and physiological tests useful in psychiatry. The book is well known, the case histories are succinctly presented, and the presentation material has that special quality of rugged common sense which Esther Richards' large audience of medical students, nurses, and laymen have always appreciated. It is noted in passing that Monez is a Portuguese, not a Frenchman.

WENDELL MUNCIE



RITUAL: PSYCHO-ANALYTIC STUDIES. *The Psychological Problems of Religion.*

By Theodor Reik, with a preface by Sigm. Freud. Translated from the second German edition by Douglas Bryan. Farrar, Straus and Company, New York. \$5.00. iv + 367 pp. 1946.

Reik's psychoanalytic investigations of certain religious rituals have long been regarded as a classic contribution to psychoanalytic literature. Originally conceived by the author in 1914-15, under Freud's guidance, these four papers were first published in an English translation in 1931. This current American edition, translated from the second German edition by Douglas Bryan, is designed no doubt to fill the increasing demand in this country for more Freudian literature and possibly also to reawaken interest in the scholarly, earnest, sometimes pedantic psychoanalytic research of which this volume is surely the prototype.

The topics selected for investigation are all interest-

ing. The first is Couvade and the Psychogenesis of the Fear of Retaliation; the second, The Puberty Rites of Savages; third, Kol Nidre; and fourth, The Shofar. The last two papers deal with orthodox Jewish ritual and attempt to trace these obscure ceremonials back into their primitive unconscious origins, parts of which have already been dissected out in the preceding papers. Reik intended this volume to be only the introduction to a much more exhaustive study of all aspects of religion. So far, he has added nothing further to this project, at least publicly; but in his introductory note for this edition he hints that he may take up the theme again.

It is a fascinating mental exercise to follow Reik's thorough, logical reasoning from statement of the details of the ritual to psychoanalytic interpretation. However, it is an exhausting exercise, too, for he employs a heavy, repetitious style which precludes facile reading. Reik is not content simply to make a point—he surrounds it from all angles, so that when he finally closes in there can be no possible doubt that it is inextricably captured. This is probably a relic of the day in which the papers were first written, when psychoanalysis had to be continually on the defensive to protect its scientific position.

This book belongs—at least partly read—in the library of every student of psychoanalysis. It is hard to think it would be of any interest elsewhere. Since Reik draws heavily on Freud's *Totem and Taboo* for reference material, and since Freud wrote a laudatory preface for the German edition (which is included in this translation), it may be assumed that Reik's reasoning and interpretations come with the real endorsement of his teacher.

HELEN HEWITT ARTHUR



DEEP ANALYSIS. *The Clinical Study of an Individual Case.*

By Charles Berg. W. W. Norton and Company, New York. \$3.50. 254 pp. 1947.

Without a doubt *Deep Analysis* is one of the most fascinating and provocative new books in the field of psychoanalysis. In it Berg attempts the impossible task of reporting in full an entire psychoanalysis. Even though he does not succeed, because of temporal and spatial limitations, his condensed report on Chris Martin is still the most complete step-by-step description of an actual orthodox psychoanalysis that is available.

The book is divided into three sections. Part I, entitled Father, begins with the initial interview, in which the highly intelligent patient presents his problem vaguely as being a sort of emotional emptiness—he isn't getting out of life the enthusiasm and enjoyment that other people seem to. The reader is then given

actual excerpts from succeeding interviews, through which Berg is able to point out how the patient has a deep and unconscious fixation on his father, reflected of course at this stage of the analysis in the patient's immediate positive reaction to the psychoanalyst.

Part II, Mother, is the next stage in the analysis, in which material relating to the patient's even earlier and more deeply repressed attachment to his mother comes out. A variety of psychoanalytic problems are illustrated graphically through these interviews—the problem of anxiety, the problem of money as a psychological issue, the problem of the etiology of accidents, and the most universal problem of all, the resistance to the psychoanalytic process. Through these by-ways of the analysis, Berg includes many of his own interpretive comments to the patient, as well as quoting Chris directly. It is a method whereby both patient and therapist are revealed, and one which few psychiatrists, therefore, have been willing to utilize so generously.

The last section, entitled Son, is Chris's final emergence from his infantile Oedipus fixation into his own role as a capable young man growing out of his childish family ties into a mature life of his own.

Berg has edited his case material intelligently as well as dramatically. The sequence of the patient's changes, his twists and turns as the psychoanalysis develops, is coherent and logical. At the same time, it possesses all the zest of a novel to a reader who has some understanding of psychoanalysis. Throughout the book, the author, as was said, interpolates explanatory passages about what is going on. Even so, it is highly debatable whether the lay reader—the dust jacket's contentions to the contrary—can really follow what the psychoanalysis is all about. To the student of psychiatry and psychoanalysis, however, *Deep Analysis* can be a valuable clinical text, and on that basis the book should be widely read.

HELEN HEWITT ARTHUR



SEX VARIANTS. *A Study of Homosexual Patterns. Second Edition.*

By George W. Henry, With Sections Contributed by Specialists in Particular Fields. Paul B. Hoeber, Medical Book Department of Harper & Brothers, New York and London. \$8.00. xxiv + 1130 pp.; ill. 1948.

In these days of rocketing book costs, it is a grateful shock to meet an expensive book reissued at a lower price (\$4.00 less, to be precise) than in its original format. This has been made possible through a one-volume edition containing all the text of the original except a glossary of the language of homosexuality and a slang vocabulary, formerly included in the appendix, and certain photographs of physical characteristics suggesting masculinity or femininity. A brief preface to

the one-volume edition discusses changes in military, legal, medical, and general public attitudes toward homosexuality. For the review of the original, see Q. R. B. 16: 507. 1941.



HUMAN BIOLOGY

PEOPLE WHO INTERMARRY. *Intermarriage in a New England Industrial Community.*

By Milton L. Barron. Syracuse University Press, Syracuse. \$3.00. xii + 389 pp. 1946.

This is a sociological study of intermarriage in the author's home town in Connecticut. He considers the conditions of intermarriage as influenced by race, ethnic grouping, and religion, and finds that racial dissimilarity proves the greatest obstacle to intermarriage whereas ethnic grouping is the least important obstacle. He finds also a general tendency for intermarriage to occur along economic educational cleavages. There is an important and useful introduction to the book, dealing with previous efforts to define terms and methodology, and with a very good historical account of the efforts, both past and present, at the institutional control of intermarriage. This is a rather important book on a rather neglected topic. The author states that only one previous book dealing with this matter has been published.

WENDELL MUNCIE



YOUR MARRIAGE AND FAMILY LIVING. *A text on (1) the history of, changes in, and problems of the American family; and (2) the adaptation of the individual as a child, a mate, and a parent in the family. The American Home and Family Series.*

By Paul H. Landis. Consulting editor: Helen Judy Bond. McGraw-Hill Book Company, New York and London. \$2.20. xvi + 373 pp.; ill. 1946.

This is a textbook on the history of changes in the American family and of its problems. It considers the adaptation of the individual within the family, as child, mate, and parent. The book is full of common information, very well presented, and with a number of telling diagrams to bring home especially important points. The information given here ought to be available to everybody who has a family or is interested in having one. Headings of the chapters will indicate the scope: 1) Changes in the American Family; 2) The American Family in Country, Town, and City; 3) Mate Selection in America; 4) Successful Marriage in America; 5) Successful Parenthood in America; 6) The Successful American Family; 7) Crises in The American Family; 8) Planning for Better Families in America. Attention is drawn not only to well-accepted fact but as well to many unsolved problems in this

field. The book could very well be recommended for use as a textbook in those high school and college courses stressing family life.

WENDELL MUNCIE



SEX, MARRIAGE AND FAMILY.

By Thurman B. Rice. J. B. Lippincott Company, Philadelphia and New York. \$2.50. 272 pp. 1946.

This is a very sensible statement of the issues indicated in the title. Written in wartime, it contains four chapters having to do with relations between young people and marriages occurring in wartime and after, eminently sensible material which might well be taken to heart even in these years of peace.

WENDELL MUNCIE



THE AMERICAN PEOPLE. *A Study in National Character.*

By Geoffrey Gorer. W. W. Norton and Company, New York. \$3.00. 246 pp. 1948.

These observations of an intelligent Englishman on typical attitudes of a large number of Americans make worthwhile reading, in so far as they are based on experience. Many of the author's theses are interesting, although neither very new nor very deep (e.g., on the anti-authoritarian and egalitarian attitude of Americans, their loneliness, mobility, the role of women, of the dollar, etc.), nor is the presentation very systematic or comprehensive. The author becomes positively ludicrous when he attempts to "explain" his data psychoanalytically (as in deriving the attitude of Senate and House from an older-younger brother pattern, or the milk consumption of American men from a hypothetical particular preoccupation with women's breasts).

Like all recent writers on "national character," the writer assumes tacitly that there exists in every nation such a thing as a single pattern of stable and nationally universal character traits. While this is understandable in non-scientific writers, one is disappointed to encounter this a priori attitude in people with a scientific training, because such a premise seems by no means scientifically established. It is primarily this preconceived opinion which makes the author present as significant national characteristics those traits, small or big, that are common either to all Anglo-Saxons, or to all modern industrialized nations or to certain classes within such nations, or to all human groups. Neither uniformity in dress, nor receptionists in restaurants, nor disorientation in child upbringing, nor vitamin rackets, nor atomization of knowledge, nor emotional memories of mass killing of pigs, etc., etc., nor, unfortunately, ethnocentrism, are "typical" American traits.

This book has not dispelled the reviewer's doubts of the particular professional qualifications of anthropologists—persons trained in the study of savage tribes and therefore in general unfamiliar with sociology, history, and non-Freudian psychology—to deal with the problem of "national character."

ERWIN H. ACKERKNECHT



THE NEGRO LOOKS INTO THE SOUTH.

By Reverend Edward Gholson. Chapman & Grimes, Boston. \$1.25. 115 pp. 1947.

A Negro reverend gives a short and unfortunately correct survey of a situation which he in one place summarizes as "ghettoes for his [the Negro's] living quarters, squalor for his environment, often inferior books for his education, less pay for his teachers, lower wages for his labor, inferior accommodations for his travel, humiliation for his presence, barriers for his higher education, political exclusion for his share in government, higher costs for lower living, and many other furtive but pricking humiliations..." The author is, on the other hand, full of understanding for the problems of the White South, and asks the church to lead towards an unavoidable change in the racial situation.

ERWIN H. ACKERKNECHT



THE WAY OF THE SOUTH: *Toward the Regional Balance of America.*

By Howard W. Odum. The Macmillan Company, New York. \$3.00. vi + 350 pp. 1947.

How true it is that the mote in another's eye is so evident, when the beam in our own is seldom noticed! It is so easy for those in the North to see and criticize social and political injustices in the South, not realizing that in their own regions of the United States there are also grave shortcomings. This beautifully written and thought-provoking book by a veteran author and professor at the University of North Carolina shows so clearly how the southern folkways, the social, cultural, and religious patterns of the four main strata of society and the dichotomy within those strata came to be. The author has given us a biography of the South. Although the folkways tend to persist to a remarkable degree, he shows that nevertheless the South is changing, and because of forces within herself. Too often criticism from the outside, particularly by those who do not fully understand the significance of the patterns they see, and who have not been watching long enough to realize that there is substantial growth and progress, throws the South back anew on its old attitudes of defense. Sudden revivifications of the old sectional conflict have occurred, once because of the depression New Deal pressure, a second time because of the pressure of war, and now again as rival candidates eye the ballot

box. So, again and again the South expends its energies in protest rather than in developing its powers. Certainly, this book should be very widely read, particularly in the North and the Far West.

ROBERT L. PENDLETON



PRAYER STICK CUTTING IN A FIVE NIGHT NAVAHO CEREMONIAL OF THE MALE BRANCH OF SHOOTINGWAY.

By Father Berard Haile. The University of Chicago Press, Chicago. \$3.00 (paper). xvi + 246 + 14 pp. + 9 plates; text ill. 1947.

NAVAHO SACRIFICIAL FIGURINES.

By Father Berard Haile. The University of Chicago Press, Chicago. \$2.50 (paper). xviii + 100 pp.; ill. 1947.

Prayer Stick Cutting is a minutely detailed presentation of the actions, prayers, and songs in the Navaho ceremony of this name. There is no general discussion. This is a factual presentation of the raw material. The Navaho text for the principal prayers and songs is given. A notable feature is the inclusion of eight plates in full color portraying the prayer sticks.

Navaho Sacrificial Figurines is a small monograph describing those minor rites practised by the Navaho in which animal figurines are used. The author in his Foreword states that these small ceremonies are conducted frequently, but remain unnoticed by the public, both native and foreign, because they are private affairs. The figurines prepared are simple; only a few intimate friends attend. The ceremonies actually seem to be excerpts from the larger chantway ceremonials.

In these two studies there is no attempt at generalization. The value of the studies, aside from their interest to students of Navaho ceremonies, lies in the included raw material for comparative studies and the incidental inclusion of much material of interest to people working in allied disciplines. For example, in *Navaho Sacrificial Figurines* there is repeated mention of the use of sweet corn in these ceremonials. This is a point of considerable interest to students of plant origins, as the occurrence of specific plants in ceremonies is often evidence of their antiquity. Sociologists and psychologists interested in primitive thought patterns would, of course, find a wealth of material in such studies.

GEORGE F. CARTER



HAWAIIAN AMERICANS. *An Account of the Mingling of Japanese, Chinese, Polynesian, and American Cultures.*

By Edwin G. Burrows. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. \$3.00. iv + 228 pp. 1947.

The war record of the 442nd Regimental Combat Team (Hawaiian Nisei), "probably the most decorated unit in the United States military history," and other symptoms of successful acculturation of "orientals" in Hawaii have provoked this attempt to survey the numerous anthropological detailed studies on the assimilation of Polynesians, Chinese, and Japanese in Hawaii. To the author the problem is one of "haole [white] prestige." This prestige was impressed upon the Polynesians mostly by armed force, upon the "orientals" by education and the whole economic set-up. The author describes faithfully how the second generation learns to despise its parents, and to acquire such essentials of North American civilization as ball games and "romantic" love; how Japanese Buddhism itself becomes Americanized, and so on. He shows that the standard answer to white domination in Hawaii has been cooperation, that aggression was always extremely rare, and that even "withdrawal" reactions (alcoholism, new cults, especially healing cults; "recreative reversion," etc.) were rather limited in scope. That this is a very rare occurrence in colonial history is well known. Why it has happened in Hawaii remains essentially unexplained by so short and superficial a book.

ERWIN H. ACKERKNECHT



VIRGIN ISLANDS. *In Story and Pictures. Pictured Geography, Fourth Series.*

By Marguerite Henry; pictures by Kurt Wiese. Albert Whitman and Company, Chicago. 75 cents. 28 pp.; ill. 1946.

A brief account of the historical, economic, and geographical features of the Virgin Islands. The illustrations are not particularly attractive to the reviewer, but the text should serve to introduce children to this little-known possession of the United States.



THE SOUTHERN AMERICAS. *A New Chronicle.*

By Abel Plenn. Creative Age Press, New York. \$4.00. xiv + 455 pp. 1948.

There is indeed great need for a better understanding of the Southern Americas and of the Caribbean—to understand how and why the social, commercial and land use patterns have developed as they have, and to understand the enormity of the curse which the Iberians laid upon their colonies from the beginning. It is also important that we in the United States appreciate at least something of the malevolent influences and pressures which have been and continue to be brought to bear from time to time upon many of the countries to the south of us; and to realize that unless we are very careful, our continued support of certain regimes will so strengthen reactionary forces that com-

munist will continue to seem the only way out for all but the wealthy few who continue to try to hold the lid down.

Particularly for tourists in California, the times and leaders of the Conquest of the western hemisphere have been glamorized. There were indeed noble characters among the clergy, both those who came in the vanguard, and those who followed through the centuries. However, the leaders of the Conquest were of different stuff. They were all too human, as is so clearly brought out in the more than 125 selections here, taken frequently from contemporary writings, and in some cases from the very pens of leaders in the events. A clearer indication of the dates of the original sources would add to the interest. These quotations make up about half the book. The author has endeavored to give unity to the chronicle with an introductory and interpretative section preceding each quotation. However, there is too much of this: these sections seem labored. At times the endeavor to achieve a poetic style, by means of excessive repetition, reminds one of an oratorio.

ROBERT L. PENDLETON



PRIMITIVE SOCIETY.

By Robert H. Lowie. Liveright Publishing Corporation, New York. \$2.49. xiv + 463 pp. [1920]; 1947.

A reprint edition, with a new preface by the author, of what has become since its first publication nearly thirty years ago a standard work in its field. The publishers are to be commended for making it available in this moderately priced and attractive edition.



TRIBES OF THE LIBERIAN HINTERLAND. *Report of the Peabody Museum Expedition to Liberia. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Volume XXXI.*

By George Schwab; edited, with additional material by George W. Harley. Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge. \$10.00 (cloth); \$7.50 (paper). xx + 526 pp. + 81 plates + 1 map; text ill. 1947.

The author and his collaborator both are "old-timers" in West Africa and have had extensive experience with the natives. Their scholarly collection of ethnological observations on the inland tribes of Liberia forms a valuable contribution to anthropological literature, in which this area has been so far very much neglected. This volume contains a wealth of new, sound information on the cultural, social, and spiritual life of the various tribes considered, but it does not attempt to make systematic comparisons or draw any general con-

clusions. The volume starts with a description of the Liberian hinterland and its human inhabitants, especially their traditions. The main topics, discussed in detail, are the following: the villages, agriculture, domestic animals, methods of fishing, trapping and hunting, food, dress, handicrafts, weapons, music, social organization, sex relations, child training, war, burial customs, religious concepts and cults, medical practices, laws, and proverbs. A final, brief summary on "native character traits" is of particular interest to biologists. Here it is stated, e.g., that "primitive Negroes are less sensitive to pain than white people," "their olfactory and taste systems do not react like ours" (decaying flesh and fish is eaten with relish and with impunity), "sight and hearing are no better than in the white race," but "the outstanding exception is the native's ability to see in blinding sunlight." "Most of the people are never far from actual hunger" and their diet as a whole "is sadly deficient in protein." Many diseases are rampant: "all natives have latent malaria all their lives," "hookworm is very common; perhaps fifty percent of the population harbor these parasites," "yaws affects even more of the natives," "gonorrhea is common, and schistosomiasis is a serious problem in the interior as is also trypanosomiasis." Perhaps worst of all is the natives' strong tendency to suppress and, if possible, to eliminate by one means or another any individuals "who stand out above the common level" and thus to discourage completely any initiative and all progress in their society.

The appendix contains a detailed glossary of native terms and notes on the native languages. The many plates of photographs are, unfortunately, quite poorly reproduced.

A. H. SCHULTZ



LAND AND POVERTY IN THE MIDDLE EAST. *Middle East Economics and Social Studies.*

By Doreen Warriner. Royal Institute of International Affairs, London and New York. \$2.50 (paper). viii + 149 pp.; ill. 1948.

This is a small book discussing a very difficult and important subject, because near starvation, pestilence, high death rates, soil erosion, and economic exploitation make up the pattern of life for the masses of the rural population in the Middle East. It is a poverty which has no parallel in Europe. Money incomes are very low, but money comparisons alone do not convey an idea of the filth and disease, and the mud huts shared with animals. As a result of the Jew-Arab controversy and the impact of power politics in this region, the peoples of the Middle East have become self-conscious. This part of the world is in a state of turmoil; it is no longer bound by tradition. Although political and national controversies again dominate the

scene, there is no organization which can put the economic progress of the Middle East or the security of the peasant population in the foreground.

The first essential is not to put more people on the land, but to raise the living standard of the population already there. All those influences which make for poverty, indebtedness, ignorance, and instability are reinforced by the social structure, particularly by the systems of land tenure, and unless this is changed there can be no real advance. Some of the conditions are best illustrated by comparing conditions in different countries. Egypt has a rural population density of 1,450 per square mile of cultivated land, ten times as high as the average density of rural population in Europe. In the last half century the population has increased faster than the increase of cropped area. The standard of living is low—the consumption of even energy-producing foods is very low. The conditions of the peasant's life are of unrelieved horror—almost a slave population. The distribution of land ownership is extremely unequal. The social system is described as feudal, but it has in fact none of the merits of feudalism, for there is no element of responsibility on the part of the landowner class. The Egyptian "pashas" are cotton lords, big business men controlling large fortunes, who hold the entire country in their grip and are utterly opposed to any measure which would raise the level of the cultivators. Although the government is in complete control of production, it will never use its powers to modify the powers of the landlords. Land reform must therefore wait upon political change, and may one day become the main motive for revolution.

In view of the aura of vast possibilities which propaganda has created around the agriculture of Palestine, it is important to remember (1) that it is a small country, and (2) that its soil is shallow and infertile. With the present amount of land, a large part of the Arab population must necessarily live on a very low level. However, there is no doubt that the standard of living of the Arab rural population there has risen during the period of mandatory rule. Palestine, by comparison with the other Middle East countries, does not suffer from the evils of absentee landlordism on a large scale. It is in the Jewish communal settlements that the most striking technical and social changes have been carried through; but from an economic standpoint they are not really a model, since they depend on the investment of very large capital resources, far beyond what can ever be made available to the Arab community. So far as grain farming is concerned, there can be no doubt that the return from farming does not cover costs.

In Iraq, by contrast, there are very disturbing trends. The sheikhs or city notables install irrigation pumps, supply them to the peasants at extortionate rates of interest, and so gradually acquire the land in payment of debt. Thus in the regions of pump irrigation the tribal system of land ownership has entirely ceased to

function. The land is mainly the property of the pump owners. During the period of the mandate some of these trends were accentuated. This wholesale alienation of the land in large blocks causes great injustice to the cultivators and also creates great obstacles to future development.

Because extreme poverty is general, and is everywhere the result of the low productivity of the land and of the excessive share of the farm income taken by the landlords, there is great need for new forms of land tenure. There is also great need for agricultural planning for the whole Middle East, planning which will cover the entire range of economic development.

ROBERT L. PENDLETON



THE EARTH'S FACE AND HUMAN DESTINY.

By Ehrenfried Pfeiffer. Rodale Press, Emmaus, Pennsylvania. \$2.75. 184 pp. + 1 plate; text ill. 1947.

As the title might suggest, the anthropomorphic point of view appears repeatedly in this small book, which contains a very curious mixture of observations, opinions, and practical suggestions for soil conservation. Strange analogies are drawn between animal organisms and the landscape. In the chapter on basic biological principles we are told that the laws relating to liquids hold good for the liquid contents of plants. And since the earth is a living organism, these laws must be valid in every part of it: "The metaphor of an organism." The theme of the book is stated to be that for the shaping of new environments, man must look to more than economics and must accept from art, science, and philosophy formative ideas. The adults of the present generation will not share in our own advanced way of thinking, will not "profit," since development of a landscape requires centuries—but spiritually that is all the more reason to redouble our efforts. The maintenance of the landscape is a cultural activity.

As would be expected in a book published in Emmaus, we find extreme statements such as that of the significance of "earthworms, without which there would scarcely be any agricultural soil," and again: "The production of a neutral humus compost or a ripe humus manure is the alpha and omega of soil culture." And we are told to use such cultural practices as will avoid the formation of a podsol! We are told further that the plow, the draft animal, and milk, important elements in present day agriculture, were first used in religious ceremonies alone and only later were converted into utilitarian purposes.

The author urges the reader to study the illustrations and their captions. Certainly the latter could, with profit, be much fuller and more explicit.

ROBERT L. PENDLETON

FARMERS OF FORTY CENTURIES or Permanent Agriculture in China, Korea and Japan.

By F. H. King; edited by J. P. Bruce. [Organic Gardening Press] Rodale Press, Emmaus, Pennsylvania. \$5.00. 379 pp.; ill. [No date.]

It is indeed a pleasure to see again in print this classic description of the agriculture of some of the best and most productive portions of China, Japan, and Korea. It was about 1906 that F. H. King spent hardly six months studying at first hand the methods and products of agriculture and truck gardening in Asia. He was indeed a most unusual and competent observer—for it is still amazing how much he recorded in notebook and by camera, and how shrewd many of his deductions were. He was much impressed with the fact that the farmers had, through empirical methods, come to use often very effective methods for conserving soil fertility, and knew how to get the utmost out of the limited areas of agricultural lands in those parts of Asia. He did not appreciate, however, that in some cases the farmers of China lose important quantities of nitrogen, for example, by following faulty empirical methods. The occidental reader cannot read this book without realizing why it is that tractors and other agricultural machinery cannot be generally used in those countries. This is indeed an essential book for all interested in the agriculture of eastern Asia.

The present edition has been well edited, without losing the flavor of the original. The text has been only slightly condensed; a careful comparison with the original edition shows that no agriculturally significant changes have been noted. The longest single deletion is of two pages, in the course of which King regrets that "the western tobacco habit, selfish beyond excuse, filthy beyond measure" had been spreading extensively in China! Portions of several pages discussing Oriental racial characteristics, and some paragraphs expressing surprise at the relative absence of flies, have also been omitted from the new edition. The number of half-tones has been reduced from 248 to 209; in many cases their quality in this edition is even better than in the original.

ROBERT L. PENDLETON



AIDS TO GEOGRAPHICAL RESEARCH. Bibliographies, Periodicals, Atlases, Gazetteers and Other Reference Books. American Geographical Society Research Series Number 22. Second Edition.

By John Kiriland Wright and the late Elizabeth T. Platt. Columbia University Press, New York. \$4.50. xii + 331 pp. 1947.

As the authors say, the main part of the volume consists of selective lists of bibliographies, periodicals, atlases, and other reference works; and its purpose is not to furnish the student with references to the pri-

many works on which to base his investigations, for no single book could do this adequately for the whole immense subject of geography. The lengthy introduction, which discusses not only the nature of geographical studies, but also the aids to geographical research, is well worthy of study by other scientists as well as geographers.

ROBERT L. PENDLETON



RURAL LIFE IN ARGENTINA.

By Carl C. Taylor. *Louisiana State University Press, Baton Rouge*. \$6.00. xxii + 464 pp.; ill. 1948.

This excellent book starts with a short, but lively, description of the author's travels through the main agricultural regions in Argentina: The cattle-breeding and the cattle-feeding belt; the corn belt; the wheat belt; the Yerba-mate belt and the cotton belt; the sugar cane, the vineyard, and the sheep belt. A systematic analysis of these regions is given in later chapters.

Population is analysed according to national origins (Spaniards and their descendants are only a minority), age, sex, etc. A historical survey of agriculture and settling shows that modern developments started only in the 1870's. In this process agriculture diversified tremendously, but remained the backbone of Argentine economy (in spite of her overgrown cities). Big land ownership still prevails in spite of the new farmer and tenant classes to which the author devotes particular attention. Argentine agriculture is highly mechanized, but transportation is still largely dependent on water courses. The farmer is often very isolated, a fact which might partly account for the high rate of illiteracy, illegitimate unions and births, and the political set-up. Compared to other South American republics material standards of living of the masses (food, health, etc.) are relatively high. There might be some causal connection with an equally relatively low birth rate. Cultural standards (education, etc.) are low. Dr. Taylor discusses also agrarian reform movements and organization.

This is a well documented, intelligent, unprejudiced, and very interesting study, one of the four or five books on Argentina in English worth reading.

ERWIN H. ACKERKNECHT



THE WAYS OF MEN. *An Introduction to Anthropology. The Century Social Science Series.*

By John Gillin. *D. Appleton-Century Company, New York and London*. \$4.50. xviii + 649 pp. + 32 plates; text ill. 1948.

This textbook of anthropology starts with a short historical sketch that is unfortunately not free from factual errors. The first quarter of the book gives a

competent survey of physical anthropology, dealing with the primates, fossil man, living races, and race mixture. Although the author takes particular pains to coordinate physical and cultural anthropology, he is not more successful than all those who made a similar attempt previously, and the wisdom of uniting both disciplines in one book might therefore be doubted.

The rest of the book is devoted to cultural anthropology. The notion of culture; its learned character, and the mechanisms of learning; its dealing with basic and acquired drives; culture patterns and integration; culture contact and culture change are discussed extensively. Types of social organization are reviewed. Probably the best chapters are those surveying the development of technology. There are rather meager chapters on symbolism and personality formation.

The book is well written and courageous. That it is so strangely abstract in some parts and relatively unsubstantial is no individual fault of the author. It is simply the consequence of his following certain contemporary trends in American anthropology. Since Linton's *Science of Man* many American anthropologists have attempted to live up to the accidental title of their profession instead of realizing that actually they are trained ethnologists, most of them able to contribute only certain stones in the building of the "science of man." The result is that they have lost contact with their own subject matter, and have, with not always very critical borrowings from neighbouring disciplines like sociology and psychology, created a theoretical system where truisms are often expressed in a highly complicated terminology. This step was perhaps unavoidable. One would feel less critical about it, were it not so often combined with an ill-founded feeling of achievement and superiority, e.g. toward the work of the late Franz Boas and his pupils who neither were, nor claimed to be, perfect but gave American anthropology internationally an unequalled position. One of the least lovable traits of this new school in American "anthropology" is its chauvinism. To single out, for instance, France as a center of prostitution (p. 495) as our author does, was entirely gratuitous, as he might meanwhile have learned from the Kinsey report.

Those who want to teach anthropology along the theoretical lines, characterized above, will find in Professor Gillin's book a well rounded and competent textbook, based on an extensive knowledge of the literature and provided with all the necessary apparatus (bibliographies, etc.).

ERWIN H. ACKERKNECHT



BIOMETRY

INDUSTRIAL EXPERIMENTATION.

By K. A. Brownlee. *Chemical Publishing Company, Brooklyn*. \$3.75. 151 pp.; ill. 1947.

Despite its title, this is a book on statistics. It is, however, designed primarily for those who are concerned with pilot-plant and plant-scale experiments on chemical manufacturing processes. The illustrations and problems are selected almost entirely from the chemical industry.

The author's emphasis is on the analysis of variance as a statistical tool. Rectilinear, curvilinear, partial, and multiple correlation, for example, are all treated as variance problems. Considerable stress has also been placed on experimental design as an integral part of statistical analysis.

On the whole, one cannot help but be impressed by the amount of solid statistical material the author has crammed into this small book. It is especially noteworthy that the author makes explicit many assumptions about the analysis of variance which are often ignored in longer texts on this subject. As an illustration, this is the first text the reviewer has seen which states explicitly that a Latin Square type of experimental design is valid only if there are no interactions between factors.

This is not an easy book to read, but it is highly recommended to statisticians and scientists with some background in statistics, whatever their fields of specialization.

A. CHAPANIS



DE OMNIBUS REBUS ET QUIBUSDEM ALIIS

THE GREAT HERITAGE.

By Katherine B. Shippen; illustrated by C. B. Falls. The Viking Press, New York. \$3.50. x + 230 pp. + 1 map; ill. 1947.

Our American heritage of furs, trees, fish, gold, oil, coal, water power, and land for wheat, corn, cotton, and tobacco, is here brought alive by inspired writing that drives home both the adventure and thrill of rapid accomplishment, and a horror of the senseless waste that accompanies it. Without proselytizing, Katherine Shippen makes conservation urgent, and shows how widely the need of it applies. To achieve this blend she has vividly retold some of the sagas of Paul Bunyan and Joe Magarac, of Johnny Appleseed and John Jacob Astor. In tracing the swift mechanization that freed hands and minds for fresh developments, there is a long and laudatory account of the Tennessee Valley Authority. No inference is drawn on the vast increase of other federal activities. The book is concerned with presenting a picture of the heritage, rather than with reporting in detail our treatment of it.

In such a condensation of three overflowing centuries, it is almost inevitable that many major factors must go unmentioned. The usual humanitarian bias is followed in discussing the achievement of Lincoln in freeing the slaves, so that there is no indication of the

slaves being more than forced labor. Yet they cost their owners money, and represented a large part of southern capital—liquidated without compensation. The mouths remained to be fed, just as the land remained to be worked. But the former slave-owners had insufficient capital left both to reconvert to the new order and also to pay the costs of their military defeat. In such an excellent and enthusiastic account of American history as this book, it seems a pity not to have made this point clear. Southerners have considerable justification for resenting its continued neglect when criticism is leveled at their present backward state.

LORUS J. & MARGERY J. MILNE



WAY OF THE WILDERNESS. A Complete Camping Manual; A How to Do It Camping Guide.

By Calvin Rutstrum. Burgess Publishing Company, Minneapolis. \$2.50 (paper). viii + 192 pp.; ill. 1946.

A camping guide, sturdily bound and in a protecting cloth case. The subject material is that usually found in such guides, but is presented in clear-cut, simple manner that makes it very readable. Many illustrations aid the explanations in the text, and the book includes pertinent remarks on recent developments in dehydrated foods and insecticides. While avoiding elaborate presentations, the author has succeeded in making a worthwhile guide that should be of interest to campers, particularly in the novice class for which it is intended.

JOHN E. CUSHING



CACHE LAKE COUNTRY: Life in the North Woods.

By John J. Rowlands; illustrated by Henry B. Kane. W. W. Norton & Company, New York. \$3.50. 272 pp.; ill. 1947.

Up somewhere in the North Woods is a small lake, known only to a few white men, far enough away to be safe from the encroachment of civilization. There in the primeval wilderness the authors built cabins and enjoyed the life that most of us live only vicariously. Month by month the reader is shown the daily activities of the two men and their Indian friend, how the forces of nature are combatted by those wise in the ways of northern winters, how the spring is prepared for and enjoyed when it finally arrives, the exploration trips in the summer, and the preparations for winter in the fall. In all these pursuits there is complete cognizance of nature, flowers and animals alike, for in the wilderness every organism has a purpose, whether merely as a harbinger of a season or as an emergency food. The reader is told all these facts, and so the book is replete

with wilderness lore. Valuable directions are given for taking care of one's self when deprived of the conveniences of a civilized existence. These include recipes, methods of constructing canoes or candle holders, and a thousand and one useful hints and cautions to be observed in order to insure a safe and pleasant life in the wilderness. Pen-and-ink drawings fill the leaf margins and depict the instructions and descriptions in the text. Sometimes the drawings are full page and illustrate the construction of hunting sleds, moccasins, ice boats, outdoor ovens, etc., or merely the beauty of the country and its animals and plants. Some of these sketches are in a highly humorous vein. Anyone who desires to lose himself away from home can do no better, other than by actual travelling, than to read this narrative.

HENRI C. SEIBERT



LAND FOR THE FAMILY: A Guide to Country Living.

By A. F. Gustafson, E. V. Hardenburg, E. Y. Smith, and Jeanette B. McCoy. Comstock Publishing Company, Ithaca, New York. \$4.00. xxiv + 501 pp.; ill. 1947.

Land for the Family constitutes a complete and practical guide to country living, written by experts. It should be of special value to people of moderate means who contemplate living in the country, or to those already there who wish to become partially self-supporting. The book deals with a wide range of topics, among which may be mentioned the selection of a community, the choice of a house and land, soils, fertilizers, and methods of cultivation, vegetable and flower gardens, landscaping, crops and fruit growing. Essential data regarding various phases of animal husbandry are included, together with information about wild life conservation and woodlands and their use. A section devoted to nutritional needs includes chapters on the kitchen, food, canning, freezing, methods of preserving, and fruit juices. Each chapter is supplied with a list of suggested readings and an adequate index is appended. The book is illustrated by over 200 photographs and drawings.

ALBERT F. HILL



STEDMAN'S PRACTICAL MEDICAL DICTIONARY. Sixteenth Revised Edition.

Edited by Norman Burke Taylor in collaboration with Allen Elsworth Taylor. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$7.50 (with thumb index); \$7.00 (without thumb index). xxxviii + 1291 pp. + 23 plates; text ill. 1946.

This sixteenth edition of a well known work, revised, enlarged and brought up to date, is certain to prove extremely useful not only to the medical profession but

to all those concerned with the biological sciences. The derivation and pronunciation of each term is given. Diseases, signs, tests, etc. are given under their specific names rather than under general categories, e.g., Gairdner's disease is under Gairdner not disease, Fehling's solution is under Fehling. Separate tables summarize and compare much useful information, e.g., weights and measures in different systems, the BNA and other nomenclatures. The book is graced by a separate and unusually complete and informative medical etymology giving both Greek and Latin roots in common medical use.

Future editions should include the commoner statistical terms. Neither mean nor mode is given, much less standard deviation or chi square. The genetics and cytology should be renovated. Genetics is defined as "the science which deals with natural development, as distinguished from eugenics, or the science of development through artificial selection." Mendel's laws are limited to plants. The haploid number of human chromosomes is given as sixteen! Mitosis is still called "indirect" cell division, while "gametogenetic mitosis" is defined as "the process of cell-division characteristic of the ovum after union with the spermatozoon, in which the number of chromosomes in each of the conjugating cells is reduced by one-half..." Biophysical and biochemical terms fare better, although the newer meanings of oscillograph and cytochrome should have been included. These are of course but details in an otherwise magnificent volume of over 1,290 pages.

GAIRDNER MOMENT



THE ELECTRON MICROSCOPE. Sigma Introduction to Science 8.

By V. E. Cosslett. Sigma Books, London. 7s. 6d. viii + 128 pp. + 12 plates; text ill. 1947.

An excellent introduction to the principles of electron microscopy, written in non-technical language that very clearly pictures the points discussed. The author first considers the general problems relative to light microscopes and from this base leads into a discussion of electrons, electron lenses, and the various methods that have been devised to make electron microscopes. The industrial, biological, and other uses of the microscope are discussed, and present problems and future possibilities considered. Many excellent illustrations accompany the text and help to make it highly desirable for the teacher or student who would like to know more of this instrument.

JOHN E. CUSHING



ANNUAL REPORT OF THE BOARD OF REAGENTS OF THE SMITHSONIAN INSTITUTION showing the operations,

expenditures, and condition of the Institution for the year ended June 30, 1946. Publication 3871.

Smithsonian Institution, Washington, D. C. \$2.25.

x + 440 pp. + 52 plates + 1 map; text ill. 1947.

In addition to the Annual Report, this volume contains the customary excellent selection of non-technical papers from a wide variety of scientific fields. The biological papers are the following: The Natural History of Whalebone Whales (N. A. Mackintosh); Life History of the Quetzal (A. F. Skutch); The Sun and the Harvest of the Sea (W. L. Schmitt); Anthropology and the Melting Pot (T. D. Stewart); Archeology of the Philippine Islands (O. R. T. Janse); The March of Medicine (M. M. Wintrobe); Technology and Medicine (K. S. Lion). In addition, general articles on the national responsibility for research and the progress of science, and special articles in other fields, such as Harlow Shapley's article on The Astronomical Dating of the Earth's Crust, and Arthur H. Compton's on Atomic Energy as a Human Asset, cannot fail to interest every scientist. It cannot be too often repeated that these collections of general papers are too good to be ignored by any scientist and particularly those who teach a science; and that similar collections published elsewhere usually cost three or four times as much.

BENTLEY GLASS



SCIENCE AND LIFE IN THE WORLD. *Volume I. Science and Civilization; The Future of Atomic Energy. Volume II. Transportation—A Measurement of Civilization; Light, Life, and Man. Volume III. A Challenge to the World. The George Westinghouse Centennial Forum May 16, 17, and 18, 1946, sponsored by The Westinghouse Educational Foundation, Pittsburgh, Pennsylvania.*

By various authors. Whittlesey House, McGraw-Hill Book Company, New York and London. \$7.50 per set of three volumes, boxed; \$2.50 each volume.

(I) x + 152 pp. + 4 plates; text ill. (II) x + 236 pp. + 1 plate; text ill. (III) x + 198 pp. + 17 plates; text ill. 1946.

The Geo. Westinghouse Centennial Forum brought together many notable scientists and educators for a series of symposia on Science and Civilization, The Future of Atomic Energy, Transportation, and Light, Life and Man. These published addresses occupy the two volumes of the set, while the third is filled with a variety of miscellaneous addresses (e.g., The Micro-zoo, by Peter Gray), a radio broadcast (Science: Salvation or Destroyer of Mankind), and a biographical study of George Westinghouse. The latter is as

interesting as anything in the three volumes. On the whole, as one might expect from a collection of published addresses to a mixed audience, the ratio of verbiage to ideas is very high.

The biological contributions to the Forum included: The Future of Atomic Energy from the Viewpoint of Biology and Medicine (W. Edward Chamberlain); Peacetime Implications of Biological Warfare (Geo. W. Merck); Light and Life—Photosynthesis (C. B. vanNiel); High-frequency Radiation and the Gene (Geo. W. Beadle); The Microbe, Friend and Enemy of Man (Selman A. Waksman); and Molecular Architecture and Biological Reactions (Linus Pauling). This symposium set a high standard, although well-informed biologists will not find in these semi-popular addresses much that they have not already read elsewhere. An exception is the address by George Merck, which still remains the sole officially released report on the preparations for and potentialities of biological warfare. He said little of a specific nature, but that little is highly illuminating—perhaps one should say that the official secrecy surrounding this subject, to an extent surpassing even that about atomic fission, is most indicative.

The addresses on Scientific Ethics (A. V. Hill), The Social Composition of Scientific Power (Isaiah Bowman), and Planning in Science (Vannevar Bush) will also interest biologists, as much for the vast difference in the three points of view as for any other reason. The spokesmen of science are by no means unanimous as to the right and proper relation of science to civilized society.

BENTLEY GLASS



SALMON FISHING ON PUGET SOUND. *How, When and Where to Troll for Salmon, Spinning, Mooching. Salmon Fishing Contribution From the Practical Side.*

By Harry W. Howard. Binfords & Mori, Portland, Oregon. \$2.50. viii + 127 pp. + 7 plates; text ill. 1947.

The information on tackle, its care and specifications, which this book supplies, should be detailed enough for any addict. Also included, as contributed chapters by other hands, are the salmon fishing laws of the State of Washington, a routine summary of the biological characteristics of the five species of *Oncorhynchus*, and a short note on the clams of Washington. There are also instructions on how to read a barometer and eight forms in the back to be filled out with records of fishing trips.

J. W. HEDGPETH

THE QUARTERLY REVIEW of BIOLOGY



THE GIANT AXONS OF ANNELIDS

By J. A. COLIN NICOL

Department of Zoology, University of British Columbia, Vancouver

THE very large nerve cells and fibres which occur in many species of annelids have always aroused considerable interest and have been the subject of numerous studies. When considered chronologically these studies show not only a gradual accumulation of information concerning giant neurones but reflect, as well, the impact of biological theories and interests in vogue at different times, and record the stimulus given to research by the discovery of new biological techniques. Throughout the nineteenth century and in the early part of the present century the intense interest in systematics led to the cataloguing and description of the Annelida. As a result of this activity there appeared the systematic and anatomical accounts of Claparède, Beddard, Meyer, Vejdovský, McIntosh, and others. As parts of larger studies these authors described the grosser features of the nervous system, recorded the presence or absence of giant fibres, and gave some particulars of their structure. More detailed knowledge awaited the introduction of greater refinements in microscopic methods—better fixatives, paraffin sections, and a greater range of selective stains. With such means, more exact studies of the annelid nervous system were rendered possible, for example, those of Friedländer, Rohde, Spengel, Retzius, and Ashworth. Towards the end of the last century a fresh impetus was given to research by the discovery of special neurological stains, methods of silver impregnation and

staining with intra vitam methylene blue, which were soon used on the annelid nervous system. These histological studies of the nervous system and the giant axons of the Annelida have continued sporadically to the present day and, in addition, have been reinforced by physiological investigations during the past few decades.

HISTORICAL

Giant nerve fibres were first described in the lobster and the crayfish by Ehrenberg in 1836, and investigations on giant axons were confined to the Crustacea for the next 25 years. Claparède (1861) revealed the existence of giant nerve fibres in the Annelida when he described an axial canal in the nerve cord of two oligochaetes, *Lumbricillus* (= *Pachydrilus*) and *Clitellio*. In a later paper (1862) he described axial canals in the nerve cords of various aquatic oligochaetes, each fibre consisting of a relatively less refringent substance than the surrounding thick sheath. Giant axons in polychaetes were observed for the first time by Keferstein (1863) in the nerve cord of *Notomastus latericeus* Sars (= *Capitella rubicunda* Keferstein). Subsequently, giant axons were recorded in numerous other oligochaetes and polychaetes, and descriptions, largely fragmentary, are available now for several hundred species of chaetopods.

The giant nerve fibres of annelids are so conspicuous, and they resemble so little the conventional picture of a vertebrate nerve fibre, that for a long time their nature was in doubt, and many

zoologists refused to believe that they could be nervous structures. Consequently, some investigators felt free to exercise their imagination in postulating function from structural appearance. The resultant crop of theories included the most diverse possibilities. Summaries of some of this literature have been given by Eisig (1887), Friedländer (1889, 1894), Lewis (1898), Ashworth (1909), and Stough (1926) under convenient subject headings like the following: giant fibres regarded as (1) true nerve fibres; (2) degenerate nerve fibres; (3) non-nervous elements, on account of their staining reactions; (4) supporting structures homologous with the notochord of vertebrates; (5) supporting structures not homologous with the notochord of vertebrates; (6) canals with no definitely stated function; (7) nutritive tubes; (8) excretory canals.

Leydig (1864a, 1865, 1886) first advanced the hypothesis that the giant fibres of the earthworm are true nerve fibres. He described them as giant dark-walled nerve fibres and stated that they stain like the nerve fibres of vertebrates, that their contents correspond to the axis cylinders and their walls to the myelin sheaths of an ordinary vertebrate medullated nerve, but that they lack an envelope corresponding to the sheath of Schwann. During the half century that followed the publication of Leydig's treatise on histology, a controversy arose concerning the significance of the giant axons of the Annelida. The nervous nature of the giant axons of the decapod Crustacea was accepted generally, but no such agreement prevailed concerning the giant axons of the Annelida, and there were as many advocates of non-nervous theories as there were supporters of a nervous function. It is to the latter workers that we owe the larger part of our knowledge of the histological structure of these axons. The proofs that they advanced for their hypothesis comprised the following details: presence of neurofibrillae in the axon; myelin sheaths; branching of the fibres; origin from nerve cells.

Schultze (1879) described neurofibrillae in the giant fibres of *Lumbricus* and established for the first time that the sheaths of these fibres are myelinated, blackening in osmium tetroxide. Langerhans (1880) used the same reagent on the giant fibres of the polychaete *Prionospio steenstrupi* Malmgren and obtained a darkening of the giant axon sheath. The next advance was due to Spengel (1881), who showed that in *Halla* (Lysaretidæ) the giant fibres arise as processes of large

nerve cells in the cord. He estimated that there are about 20 such cells and since the number of large nerve fibres remains fairly constant (about 7) in any one animal, he concluded that a fusion of processes must occur. This account has especial interest in that it introduces the concept of syncytial giant axons which since that time have been demonstrated in a number of invertebrate phyla, although it must be stated that Ashworth (1909) subsequently showed that the giant axons of *Halla* are unicellular structures and that the relatively small and constant number of giant axons in this species is due to termination of the fibres at successive levels in the nerve cord. The nerve cells of the giant axons, in general, have proved to be very elusive structures, and there is probably no species of annelid in which the arrangement of giant axon nerve cells has been determined with as rigorous proof as that used in studies of vertebrate neurology. Rohde (1887) described some of the nerve cells of the giant fibres in the Aphroditidae, Sigalionidae, and Polynoidae, and finally Friedländer, in three papers that are now classical (1888, 1889, 1894), traced the connexions between giant axons and nerve cells in *Lumbricus* and *Mastobranchus* (Capitellidae) and definitely established the fact that giant axons of these two animals are syncytial structures.

Subsequent to 1900 the nervous nature of annelid giant fibres received nearly universal acceptance, but the substantiating evidence was entirely histological and far from complete. It was only in a small number of species that the nerve cells of the giant fibres had been found; in other species the nerve cells were sought in vain. Neurofibrillae were seen in the giant fibres of some oligochaetes and of a few polychaetes, but again were by no means universal. The myelinated sheath of the giant fibre was certainly dissimilar to that of a vertebrate nerve fibre, in that it contained connective tissue and lacked a circumscribing neurilemma and nodes of Ranvier. Moreover, its presence had been established only in lumbricids and a few polychaetes. The methods used to reveal the occurrence of myelin included: oxidation by osmium tetroxide, staining with quinolein blue, solubility in alcohol, fixation by chrome salts and birefringence under crossed-Nicols. Not all of these methods are equally reliable. The reduction of osmium tetroxide is not specific for fatty material, although it does occur in the presence of unsaturated fats. It is a useful morphological aid (Dempsey and Wislocki, 1946), but since reduction

is induced by other substances also, and since the conditions for this reaction are variable and difficult to control, it is a very unreliable agent for the detection of diffuse and scanty lipoids (Baker, 1944; Lison, 1936; Owens and Bensley, 1929). Friedländer (1889) found that the sheaths of the giant axons of *Lumbricus* and *Mastobranchus* appear birefringent in polarized light, but in these animals the sheaths contain a considerable amount of lipid that stains with osmic acid; in *Dasybranchus* (Capitellidae) he found the birefringence of the giant axons to be much weaker. The methods available to Friedländer were inadequate to make a quantitative study of axon sheath birefringence and myelination, for it is only recently that Bear and Schmitt (1937) have shown by special methods of analysis that the birefringence of invertebrate axon sheaths varies in a continuous manner from the largest to the smallest fibres. They have stated, moreover, that the ultra-structure of the sheaths of unmyelinated fibres is essentially similar to that of myelinated fibres, and they refer differences in the physical and optical properties of these two arbitrary categories of fibres to variations in the relative proportions of oriented lipid and protein molecules present. No significance attaches to results obtained with quinolein blue. According to Gatenby and Painter (1937), this dye was employed by Ranvier for showing fatty material, but the composition of the dye used is unknown.

Friedländer (1889) believed the giant fibres to be especially long axons that conduct nerve impulses causing widespread contraction of longitudinal muscles, but his experimental proof for this hypothesis was inadequate. Bovard (1918b) attacked the problem again when he discovered that the giant nerve fibres of the earthworm regenerate more slowly than the rest of the nerve cord after transection. In correlation with this fact, he observed that there is a corresponding delay in the return of end-to-end contractions of the entire body, in contrast to the earlier return of slower peristaltic movements. Yolton (1923) and, subsequently, Stough (1930) and ten Cate (1938) made a direct approach to the problem by cutting the giant fibres of the earthworm without interrupting the rest of the nerve cord, and they found that the quick contraction proceeds only as far as the cut region. Finally, Eccles, Granit, and Young (1933), Rushton (1945a, 1946) and Bullock (1945a) have recorded action potentials of earthworm giant fibres electrically, and have proved that they are

nerve axons and that their action potentials bear a definite relation to the quick contractions of the animal. More recently, Bullock (1945b, 1948) and Nicol, Smyth, and Whitteridge (1947) have made studies of the giant axons of a number of polychaetes, and have revealed further details of the functional organization of polychaete giant fibres.

Giant nerve fibres or giant axons may be defined as nerve fibres, in any species, that are disproportionately greater in size than the other nerve fibres of the animal. In absolute units they may be rather small, although having strikingly greater dimensions than other axons in the same individual. A functional distinction can be drawn as well, since in all invertebrates in which this aspect has been investigated it has been shown that they are concerned with quick escape or withdrawal movements, effected by widespread and synchronous or nearly synchronous muscular contractions (Young, 1944). It may be necessary to modify this criterion as more is learnt of the function of these structures in various groups, but the existing evidence is compatible with this viewpoint. It is in these meanings, of relatively large size and escape function when known, that the term giant axon is employed in the following discussion.

As far as possible the classification and nomenclature of the Annelida in this review conform to recent authorities. For the Polychaeta, the works of Fauvel (1923, 1927) and Hartman (1936, 1938, 1942a, 1942b, 1944, 1948) have been consulted. Since many workers have referred to *Lumbricus* or the earthworm, there is little value in presenting a detailed analysis of specific differences in the Oligochaeta, particularly the Lumbricidae, but where necessary the well-known monographs of Beddard (1895) and Stephenson (1930) have been used.

OCCURRENCE OF GIANT AXONS IN THE ANNELIDA

Giant axons have been described in various members of three annelid groups, the Archiannelida, the Polychaeta, and the Oligochaeta. These will be considered in turn.

Archiannelida

The situation in the Archiannelida is obscure, since no author who has studied the central nervous system of this group has regarded the giant fibres as nerve fibres. Perrier (1897) stated that giant nerve fibres are absent in *Polygordius* and *Protodrilus*; however, Hatschek (1878), Fraipont (1887),

and Hempelmann (1906) have described medullary canals or small spaces in the developing nerve cord of *Polygordius*. Hempelmann, in particular, followed this canal system into the oesophageal connectives and found that it terminates among the nerve cells of the supraoesophageal ganglia. It is very probable, especially from Hempelmann's description, that there is a giant fibre system, in *Polygordius* at least, among the Archiannelida. One or several giant fibres extend from the supraoesophageal ganglia throughout the length of the nerve cord. There is no information available for the cell bodies and branches of these giant axons, and their structure and arrangement need to be reinvestigated.

Polychaeta

Giant nerve fibres are of widespread occurrence in the Polychaeta, and they form a conspicuous part of the central nervous system of many species. They have been identified with certainty in the following families: Aphroditidae, Polynoidae, Sigalionidae, Nephtyidae, Nereidae, Glyceridae, Eunicidae, Lysaretidae, Lumbrineridae, Onuphiidae, Orbiniidae, Spionidae, Magelonidae, Disomidae, Cirratulidae, Opheliidae, Capitellidae, Arenicolidae, Maldanidae, Sabellariidae, Ampharetidae, Terebellidae, Sabellidae, and Serpulidae. In addition, they may be present in some species of the Amphinomidae, Arbellidae, Polyodontidae, Goniadidae, and Flabelligeridae. As far as can be determined from an examination of scattered accounts, they are absent in the Phyllodocidae, Syllidae, Tomopteridae, Chaetopteridae, Scalibregmidae, and Pectinariidae. This leaves a number of families for which no information is available.

Aphroditidae. Long distance giant axons running through several segments are absent in species of this family (*Aphrodita* and *Hermione*), according to Bullock (1948), Cunningham (1887), and Rohde (1887). The latter investigator, however, found large intrasegmental nerve fibres in these animals. The fibres enter lateral nerves proceeding to the body wall and appear to arise in each segment from nerve cells lying in the lateral and ventral regions of the nerve cord.

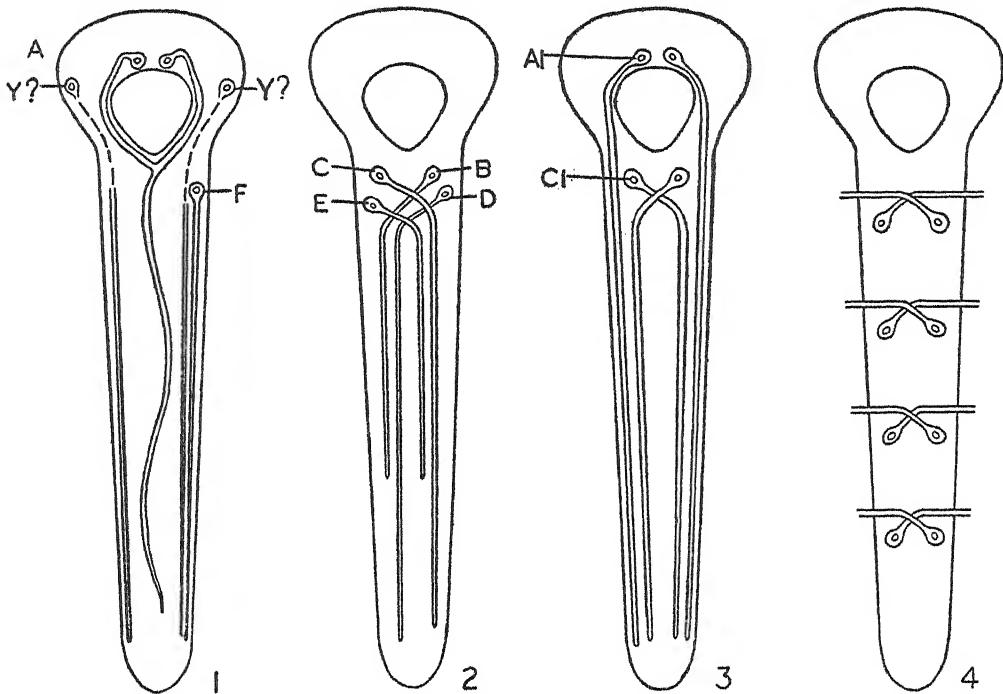
Sigalionidae. In this family giant axons are known to occur in species of *Euthalenessa*, *Leanira*, and *Sigalion* (Cunningham, 1887; Darboux, 1899; McIntosh, 1885). Rohde (1887) has made the only detailed study of them (Figs. 1-3). Well-

developed giant fibres, which extend long distances through the central nervous system, are present in *Euthalenessa* (= *Sthenelais*) *dendrolepis* Claparède and *Sigalion squamatum* Delle Chiaje. Rohde observed that the majority of giant fibres arise from giant nerve cells and are unicellular, that is, one giant fibre arises from one giant nerve cell. In *Euthalenessa*, however, there is one giant axon which arises from the fusion of the processes of two nerve cells lying in the supraoesophageal ganglia. The majority of giant fibre cells lie in the nerve cord, but in both *Euthalenessa* and *Sigalion* one of the giant fibres in the cord arises from nerve cell(s) in the supraoesophageal ganglia. It is necessary to add, however, that Rohde was not successful in discovering the nerve cell bodies of all the giant fibres which he described. Some of the giant fibres extend antero-posteriorly (*Euthalenessa*, *Sigalion*) but, in addition, postero-anterior fibres may be present (*Euthalenessa*), and the cell bodies have a corresponding location. The giant fibre sheaths are not osmiophilic. Besides fibres running a considerable distance in the central nervous system, giant cells with axons confined within the limits of one segment occur in *Euthalenessa*. The axon of each cell crosses the nerve cord to enter the body wall of the opposite side within the same segment (Figs. 5, 6).

Polynoidae. Intersegmental giant axons occur in the polynoids *Harmothoe*, *Lagisca*, *Lepidametria*, and *Lepidasthenia* (Bullock, 1948; Cunningham, 1887; Michel, 1899). Rohde (1887) has dealt with the giant axons of *Lepidasthenia* (= *Polynoë*) *elegans* Grube at some length, and Haller (1889) subsequently added further details (Fig. 4). There are two pairs of giant fibres, a middle pair, and two larger lateral fibres. Both authors stated that these run antero-posteriorly but disagreed as to their cellular origin. Rohde followed the lateral fibres into the oesophageal connectives and suggested that they arise in the supraoesophageal ganglia; he associated the medial fibres with contralateral giant cells in the suboesophageal ganglia. Haller considered that the lateral fibres arise in the third segment; he also discovered segmental branches that extend towards the lateral muscles from these axons. Intrasegmental giant fibres occur in the nerve cord as well: each fibre arises from a large nerve cell, crosses the cord, and enters a peripheral nerve. *Harmothoe*, *Lepidametria*, and *Lagisca* have a pair of intersegmental giant axons. *Nephtyidae*. A number of authors have described

giant nerve fibres in the neuropil of the nerve cord of several species of *Nephtys* (Cunningham, 1887; Ehlers, 1868; Emery, 1886; McIntosh, 1885; Michel, 1898, 1899; Pruvot, 1885; Retzius, 1891; Saint Joseph, 1894; Schack, 1886; Spengel, 1881); but no author has directed his attention to making a detailed anatomical study of these structures. Although there is a considerable amount of variation in the descriptions, they indicate that there are four large fibres and several smaller ones ex-

Glyceridae. Several species of *Glycera* and *Hemipodus* (?) contain relatively small giant axons. There are two dorso-medial giant fibres in the nerve cord of most species and several other similar and smaller fibres (Ehlers, 1868; Eisig, 1887; McIntosh, 1877, 1885, 1923; Michel, 1899; Saint Joseph, 1894). In *Glycera dibranchiata*, Bullock (1948) found four pairs of large fibres and one to three pairs of small variable fibres. Corresponding to this arrangement, up to eight separate spike



FIGS. 1 TO 4. DIAGRAMS OF THE GIANT AXONS OF THE SIGALIONIDAE AND POLYNOIDAE

Based on the descriptions by Rohde (1887) and Haller (1889). The letters are Rohde's original designations. Figs. 1 and 2. *Euthalenessa* (= *Sthenelais*) *dendrolepis*. A, Bicellular giant axon arising from two cells in the supraoesophageal ganglia. B, C, D, E, F, unicellular giant axons arising from nerve cells in the suboesophageal region. Y, possible cell body of another intersegmental giant axon. Fig. 3. *Sigalion squamatum*. Al, Cl, unicellular giant axons arising in the supraoesophageal ganglia and in the anterior nerve cord, respectively. Fig. 4. *Lepidasthenia* (= *Polynoë*) *elegans*. Intrasegmental decussating giant axons proceeding to the body wall.

tending long distances in the nerve cord. Bullock (1948) also has recorded spike potentials from *Nephtys* corresponding to four main fibres.

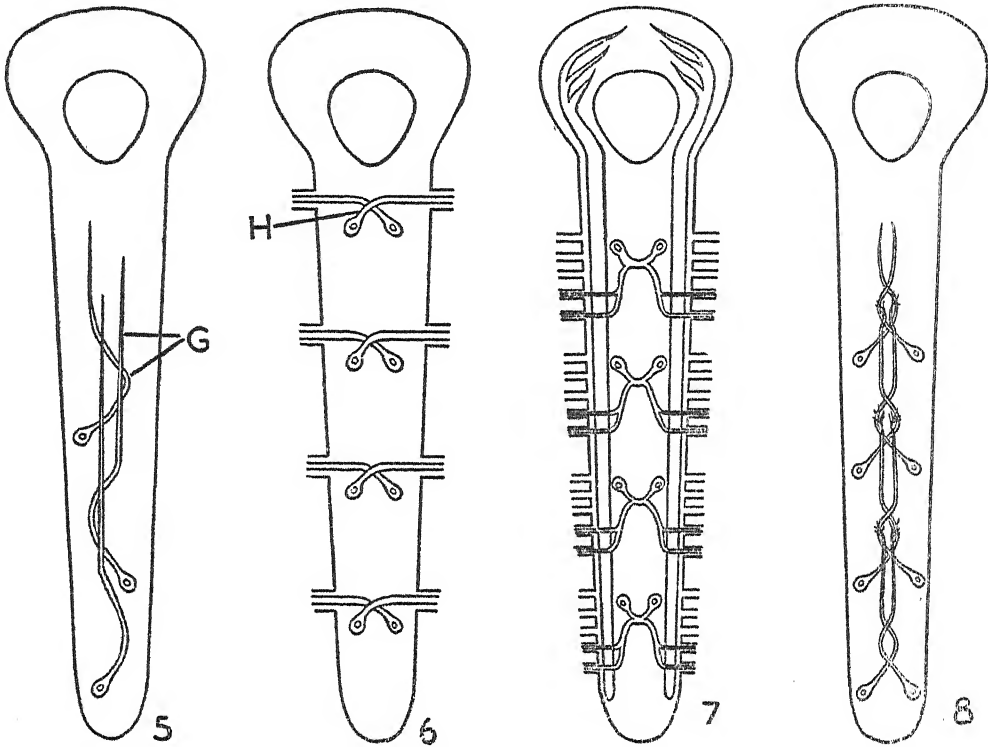
Ichthyotomidae. Eisig (1906) described two types of giant fibres in the nerve cord of the parasitic species *Ichthyotomus sanguinarius* Eisig. Nerve fibres of the first type extend considerable distances in the nerve cord; the nerve cell bodies of these fibres are unknown. Fibres of the second type arise from giant nerve cells in each segment and enter the peripheral nerves of the same metamere.

potentials were recognized. Gravier (1898) suggested that the giant axons arise from very large nerve cells which occur in the supraoesophageal ganglia. In the nerve cord of *Glycera convoluta* Keferstein, the giant axons are recognizably much larger than the other axons of the cord, a median pair having an average diameter of 29μ , and several smaller fibres in the dorsal neuropil having an average diameter of 22μ . Processes of the giant cells in the supraoesophageal ganglia appear to enter the oesophageal connectives but they are

indistinguishable from the other nerve fibres of the connectives and have not been traced to the suboesophageal ganglia (Nicol, 1947). The giant axons of this family require further investigations to clarify their anatomical and functional arrangement.

Nereidae. Several giant axons occur in all species of *Nereis* which have been examined, and in *Perinereis* (= *Nereis*) *cultrifera* Grube (Cunningham, 1887; Dehorne, 1935; Ehlers, 1868; McIntosh,

anastomosing fibres in each segment; these latter arise from a pair of nerve cells, and a fibre extends from the point of fusion to enter a peripheral nerve on either side of the nerve cord. In addition, there is a third pair of smaller median fibres which extend anteriorly through two segments only. These fibres are unicellular, decussate with each other several times, but remain anatomically distinct. Retzius (1891) observed neurones in the nerve cord similar to the decussating and anastomosing



FIGS. 5 TO 8. DIAGRAMS OF THE GIANT AXONS OF SIGALIONIDS (5, 6) AND OF NEREIDS (7, 8)

Figs. 5 and 6. *Euthalenessa dendrolepis*. G, postero-anterior intersegmental giant fibres. H, intrasegmental giant axons (based on Rohde, 1887). Figs. 7 and 8. *Neanthes virens*. Description in text (based on Hamaker, 1898).

1877, 1885, 1923; Michel, 1898; Nansen, 1887a, 1887b; Schröder, 1886). Hamaker (1898) has given a detailed account of these structures in *Neanthes* (= *Nereis*) *virens* Sars (Figs. 7, 8, 9, 13). A pair of large lateral fibres and a single smaller median fibre extend throughout the nerve cord. The median fibre is connected with one or more cells in the suboesophageal ganglion; the lateral fibres pass into the oesophageal connectives and possibly extend into the supraoesophageal ganglia. The lateral fibres are in contact with a pair of

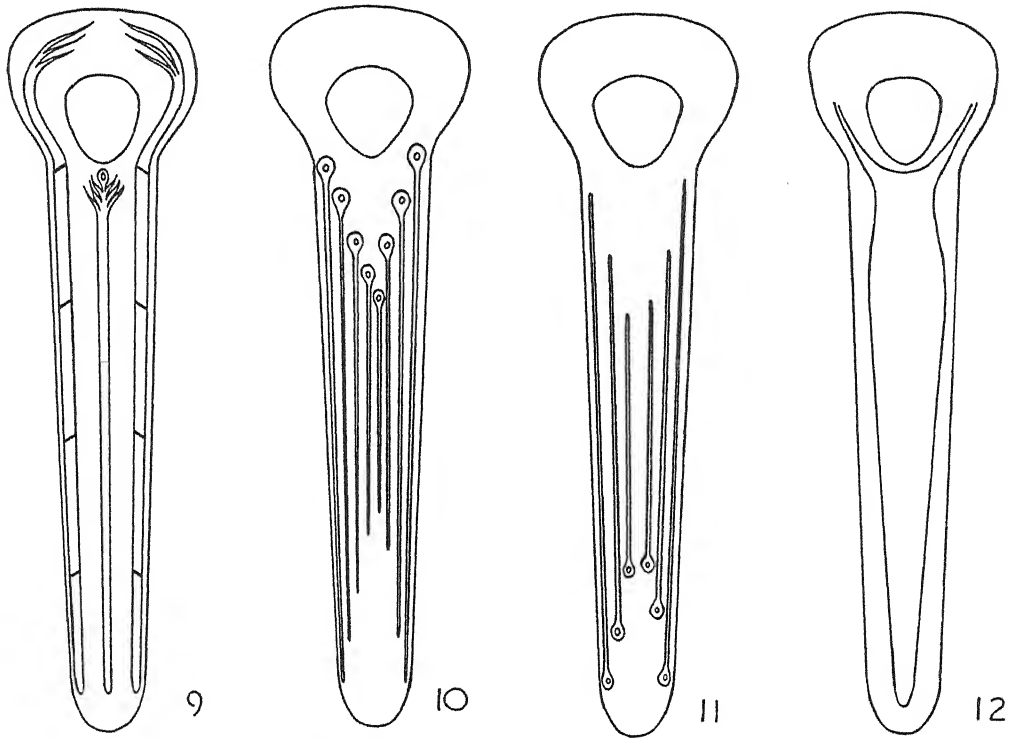
fibres described by Hamaker (1898). The giant axons of *Perinereis cultrifera* are not myelinated by histological standards (Ehlers, 1868). In a paper devoted largely to the earthworm, Stough (1926) described intersegmental macrosynapses or transverse septa in the lateral giant fibres (*Nereis*). Finally, Bullock (1945b, 1948) has recorded action potentials corresponding to the five giant axons of *Neanthes virens*. He concluded that the several giant axons (with the possible exception of the medial pair) conduct impulses independently

of each other, either anteriorly or posteriorly, following tactile or electrical stimulation. Definite regions of the body discharge certain giant fibres only. Hamaker figured an overlapping of the successive giant fibres of the medial pair, and Bullock (1948) suggested that this arrangement permits at least unpolarized functional junctions in series through the cord.

Eunicidae. Giant axons are very large and form a considerable proportion of the nerve cord in the Eunicidae. There is a single large axon in *Eunice*

Nerve cells, branches, and other details of the giant axon are unknown.

Arabellidae. Livanoff (1924) and Spengel (1881) have described giant axons in *Arabella*. Five to six large fibres are present in the medio-dorsal region of the nerve cord. Giant nerve cells occur in the anterior ganglia in segments II to XX (Fedorow, 1928; Livanoff, 1924), and according to Spengel (1881) they form multicellular giant axons. The length, course, and arrangement of giant axons in this genus are by no means firmly established



FIGS. 9 TO 12. DIAGRAMS OF GIANT AXONS OF NEREIDS AND LYSARETIDS

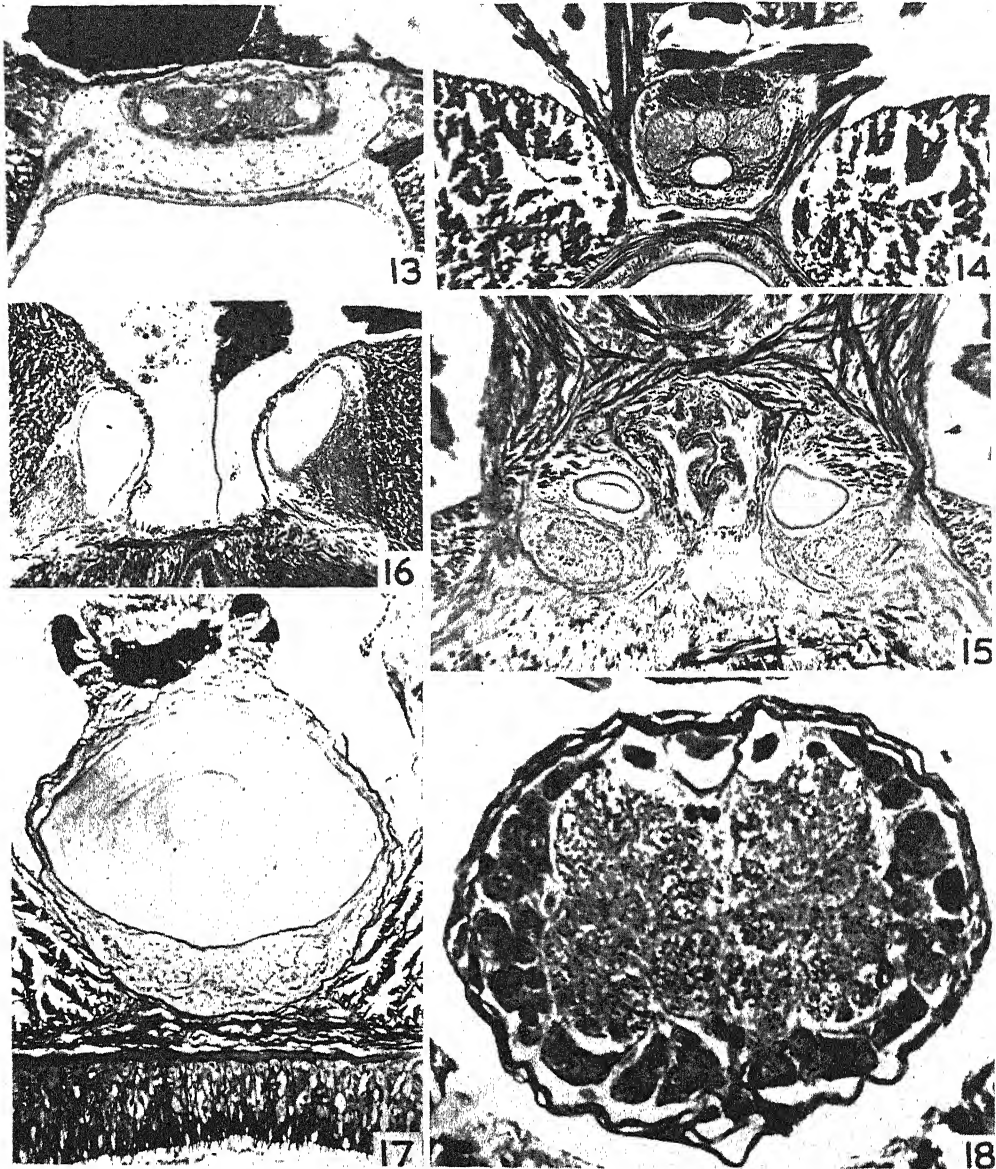
Fig. 9. Medial and lateral giant fibres of *Neanthes virens* (based on Hamaker, 1898, and Stough, 1926). Figs. 10 and 11. Antero-posterior and postero-anterior giant fibres of *Halla* and *Agaurides* (based in large part on Ashworth, 1909). Fig. 12. Single giant axon of *Eunice* (based on several authors).

(many species), *Marphysa*, and *Lysidice* (Jourdan, 1887; Livanoff, 1924; McIntosh, 1877, 1885, 1923; Pruvot, 1885). In *E. rousseaui* Quatrefages (= *E. violacea*), the giant axon extends into the oesophageal connectives (Keyl, 1913), possibly to end in the supraoesophageal ganglia (Figs. 12, 14). Diameters of the nerve fibre in trunk segments are about 100μ in *E. rousseaui* and *E. harassi* Aud. and M.-E (Ehlers, 1868; Keyl, 1913; Nicol, 1947). The diameter is greatest in the anterior segments and decreases posteriorly (McIntosh, 1877).

however. Bullock (1948) found that the giant axons are relatively small and inconstant in number. No distinct giant spike potential was recorded, but there was evidence for some rapid pathway in the nerve cord. In another genus, *Drilonereis*, giant axons are absent (Spengel, 1881). *Lumbrineridae*. Conspicuous large nerve fibres are present in *Lumbrineris* (several species), but there is considerable divergency in descriptions of their number, stemming either from species differences or more probably from incompleteness of

observation. Michel (1899) and McIntosh (1923) mentioned four fibres, two median, one above the other, and two paired, one on either side of the cord.

Spengel, 1881). Bullock (1948), however, has confirmed the existence of four giant axons and has shown that they form through-conducting path-



FIGS. 13 TO 18. PHOTOGRAPHS OF TRANSVERSE SECTIONS OF THE NERVE CORDS OF ANNELIDS TO SHOW GIANT AXONS

Silver impregnation. Fig. 13. *Nereis diversicolor*. Five giant axons visible. $\times 79$. Fig. 14. *Eunice harassi*. Single giant axon. $\times 51$. Fig. 15. *Branchiomma vesiculosum*. Pair of giant axons. $\times 51$. Fig. 16. *Sabella pavonina*. Pair of giant axons. $\times 51$. Fig. 17. *Myxicola infundibulum*. Single giant axon. $\times 79$. Fig. 18. Earthworm. Three giant axons in dorsal (upper) part of nerve cord. $\times 466$.

Only one or two nerve fibres have been described by other observers, usually the large medio-dorsal axon (Fedorow, 1928; McIntosh, 1885, 1923;

ways. They probably arise from large nerve cells in the anterior ganglia (Fedorow, 1928; Spengel, 1881).

Lysaretidæ. Good descriptions are available for the giant axons of two species of lysaretids. This is due in part to the fact that the giant fibre nerve cells are particularly large, thereby facilitating the study of these structures.

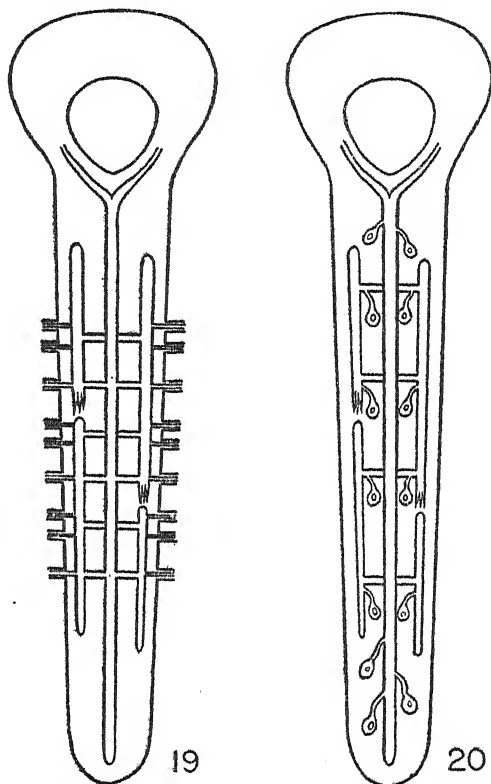
Giant axons have been noted in *Halla* by Claparède (1868), Spengel (1881), and Haswell (1886), while Ashworth (1908, 1909) has given a lengthy account of the giant fibres of *H. parthenopeia* Delle Chiaje. The last author found 2 sets of giant fibres: an antero-posterior group arising from 15 to 21 giant nerve cells in the anterior segments; and a postero-anterior group arising from 6 to 8 smaller nerve cells in the posterior segments. The anterior giant cells vary from 30μ to 150μ in diameter, and the axons from 8μ to 40μ . The giant axons are unicellular, do not anastomose with one another, and give off a number of fine branches into the neuropil of the nerve cord. They run long distances in the cord, some of the antero-posterior fibres extending to within 1 or 2 mm. of the posterior end of the animal. These giant axons are not myelinated, in the usual sense of the word. Ashworth (1909) also found that a similar arrangement of giant axons occurs in *Aglaurides fulgida* Savigny (Figs. 10, 11). Giant axons are absent in the parasitic species *Oligognathus bonelliae* Spengel (Spengel, 1881).

Onuphidæ. The Onuphidæ in general are characterized by a very large axon extending long distances in the nerve cord. Genera which have been examined include *Hyalinoecia*, *Nothria*, *Diopatra*, and *Onuphis* (Bullock, 1948; Livanoff, 1924; McIntosh, 1877, 1923; Pruvot, 1885). The giant axon of *Hyalinoecia tubicola* O. F. Müll. is of extraordinarily large size, 500μ . Very little is known of the giant axons of this family; their simplicity of arrangement and size should make them a profitable subject for neurological study.

Orbiniidæ. Giant nerve fibres have been mentioned several times as occurring in this family. According to McIntosh (1923) and Michel (1899), there is a single large dorsal fibre and a pair of discontinuous smaller fibres beneath it in various orbiniids, including *Orbinia* (= *Aricia*). Other authors have described one or two giant fibres in the nerve cord of *Aricidea*, *Naineris*, and *Scoloplos* (Claparède, 1868; Cunningham, 1887; McIntosh, 1877, 1885; Saint Joseph, 1894). These accounts are too fragmentary for any conclusions to be drawn concerning their arrangement and form. Recently Bullock (1948) has recorded from *Haplo-*

scoloplos bustorus two giant spike potentials which are related to two inconspicuous median giant fibres.

Arenicolidæ. Giant axons are known to occur in most species of *Arenicola* but are absent in *A. claparedei* Levinson and in the related genus *Branchiomaldane* (Ashworth, 1903, 1904, 1910a, 1910b, 1911, 1912; Claparède, 1868; Cunningham, 1887; Fauvel, 1899; Gamble and Ashworth, 1898,



FIGS. 19, 20. DIAGRAMS OF THE GIANT AXONS OF *ARENICOLA*

Based on Ashworth (1904) and Gamble and Ashworth (1900). All three fibres anastomose with one another.

1900; Saint Joseph, 1894). Where they occur, there is one fibre anteriorly, two or three in the central body region, and one posteriorly (Figs. 19, 20). All fibres anastomose with one another in each segment; they constitute, therefore, a composite unit. Bullock's record (1948) of a single spike potential from *Arenicola cristata* Stimpson offers confirmation of this arrangement. One or two large nerve cells in each metamere join the giant fibres either directly or by means of commissural branches between the latter; these giant fibre

cells are 50μ – 80μ in diameter. Three pairs of branches proceed from the giant fibres into the peripheral nerves in each segment (Figs. 19, 20). The sheaths of the giant axons of *A. grubei* are slightly osmiophilic (Gamble and Ashworth, 1900). In effect, there is only one giant fibre in the nerve cord; it is subdivided into several strands in each segment and arises from many nerve cells. Since its branches pass directly into the peripheral nerves, it represents the final common path for the effector organ which it innervates (on the assumption that peripherally located ganglia and motor neurones are absent).

Maldanidae. Giant axons occur in species of *Maldanella*, *Nicomache*, *Clymene*, and *Clymenella* (Cunningham, 1887; Lewis, 1898; McIntosh, 1885, 1923), but these neurones have been described adequately only in *Clymene producta* Leidy and *Clymenella* (= *Axiolthea*) *torquata* Leidy (Lewis, 1898). In *Clymene producta*, Lewis (1898) found a single giant axon which bifurcates and terminates in a pair of symmetrically placed large nerve cells in the suboesophageal region. In *Clymenella torquata* two fibres are present: one as far as segment 7, two fibres from segments 7 to 19, and one fibre from segments 19 to 22, where it terminates. Lewis believed these two fibres to be divisions of the same axon, but Bullock (1948) considered that two distinct giant axons are present and that they represent separate through-conducting pathways. In both species the nerve fibres are connected with numerous large unipolar nerve cells lying in the ventral region of the cord and are therefore syncytial (Fig. 22). Diameters measured from Lewis's illustrations are: giant axons of *C. producta*, 19μ – 32μ ; giant fibre cells of *C. torquata*, 20μ – 52μ . Lewis emphasized that the neuroplasm of giant fibre cells and giant fibres become continuous with one another. The axons have a myelin sheath that blackens with osmic acid.

Ampharetidae. Giant axons occur in the ampharetids *Melinna*, *Phyllocomus*, *Amphicteis*, and *Ampharete*, either in the thorax alone or in the thorax and abdomen (Cunningham, 1887; Fauvel, 1897; McIntosh, 1885, 1923). They apparently arise from giant nerve cells in the thoracic region, and since these cells are numerous and the fibres few in number, the fibres may be syncytia connected with a number of cells. Finally, the variation in the number of giant fibres at several levels indicates that they branch and anastomose

with one another. If the interpretations given here are correct, then the giant axons of the Ampharetidae resemble those of the Maldanidae rather closely, with the exception that in the former family the giant fibre cells are localized in the anterior segments.

Capitellidae. The several accounts dealing with the giant fibres of the capitellids reach sizeable proportions, but despite their magnitude the conclusions which can be formulated are very slender. Giant nerve fibres running through the greater part of the nerve cord are widespread in members of this family. There are one to four giant axons in different parts of the nerve cord, and they are apparently syncytia connected with numerous large nerve cells either widely distributed in the cord (*Mastobranchus*) or aggregated in the anterior region (*Notomastus*). Cross connexions between the two lateral fibres have been observed in *Mastobranchus* (Fig. 21), and it is possible that in some of the other genera the giant fibres are connected with one another (Claparède, 1863, 1868; Cunningham, 1887; Cunningham and Ramage, 1888; Dehorne, 1935; Eisig, 1887; Friedländer, 1889; Keferstein, 1863; Livanoff, 1924; McIntosh, 1877, 1885, 1923; Saint Joseph, 1894). The fibres vary considerably in diameter in different regions, and in *Mastobranchus* there are clearly marked constrictions arranged segmentally (Fig. 21). This form also has a very well developed myelin sheath (Friedländer, 1889), probably the best developed in the Annelida, but the occurrence of myelin sheaths in other genera has not been proven.

Spionidae. Giant nerve fibres are well developed in this family. One or two axons occur in *Polydora*, *Prionospio*, *Scolecopsis*, *Nerine*, *Laonice*, and *Pygospio* (Attems, 1903; Claparède, 1868, 1873; Cunningham, 1887; Cunningham and Ramage, 1888; Jacobi, 1883; Langerhans, 1880; McIntosh, 1885, 1923; Michel, 1898, 1899). They have diameters of 22μ – 30μ in species of *Polydora* (Jacobi, 1883) but are said to be enormous in *Nerine cirratulus* Delle Chiaje (Michel, 1899). Langerhans (1880) observed that the giant axons of *Prionospio steenstrupi* Malmgren originate in the supraoesophageal ganglia and are myelinated, and Michel (1899) stated that those of *N. cirratulus* show regular segmental alterations in diameter. According to McIntosh (1923), the two giant axons in the anterior segments of *N. foliosa* Aud. and *M.-E. fuse* to form a single giant axon more

posteriorly. The nerve cells of these fibres are not known.

Terebellidae. Giant axons in this family show a considerable amount of variation and are absent or small in *Amphitrite*, *Terebellides*, and *Thelepus*, and well differentiated in *Eupolymnia* (= *Polymnia*) (diameter 28μ), *Pista*, and *Lanice conchilega* Pallas (Bullock, 1948; Claparède, 1873; Cunningham, 1887; Dehorne, 1935; McIntosh, 1885, 1923;

the *Hermelliformia* as in the *Sabelliformia* and represent an adaptation to a similar sedentary mode of life. The nerve cord of *Sabellaria* is built on a ladder-like pattern, and each half of the cord contains a large nerve fibre (Cunningham, 1887; McIntosh, 1877, 1885, 1923; Meyer, 1887, 1888; Michel, 1899).

Magelonidae. McIntosh (1878) and Cunningham (1887) have described a large axon in *Magelona*.

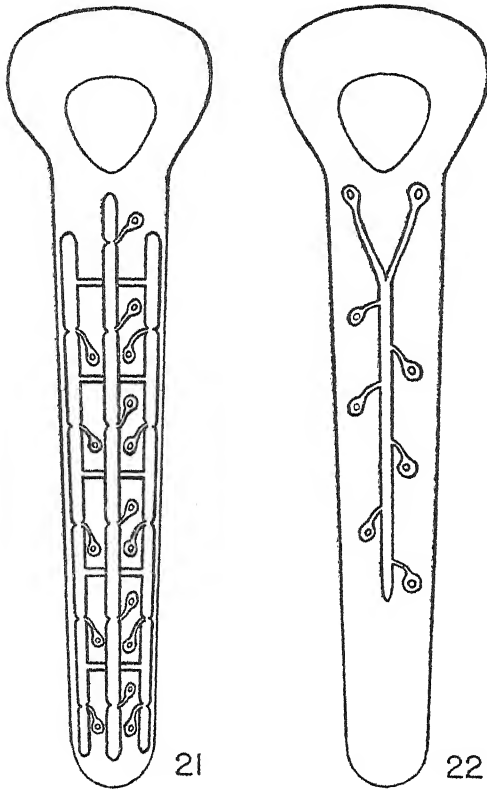


FIG. 21. DIAGRAM OF THE GIANT AXONS OF *MASTOBRANCHUS*
Based on Friedländer, 1889

FIG. 22. DIAGRAM OF THE GIANT AXONS OF *CLYMENE*
(Lewis, 1898)

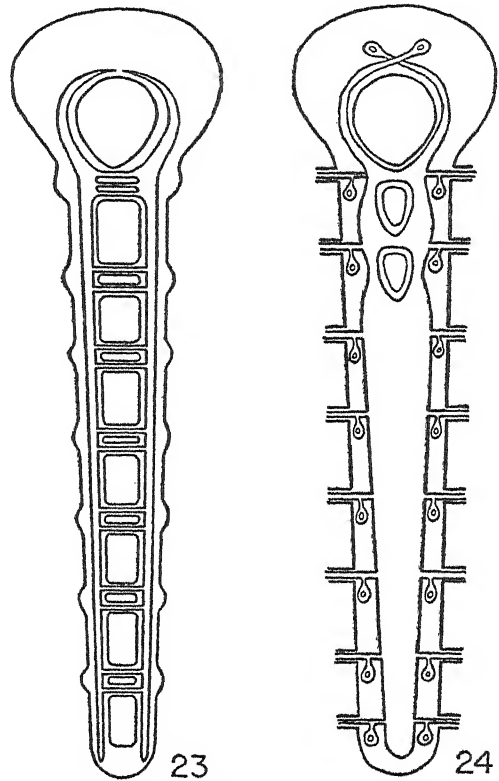


FIG. 23. DIAGRAM OF THE GIANT AXONS OF *SABELLA* AND *SPIROGRAPHIS*

FIG. 24. DIAGRAM OF THE GIANT AXON OF *MYXICOLA INFUNDIBULUM*
(Sources in text)

Saint Joseph, 1894; Steen, 1883). Steen (1883) found that the two giant axons in the anterior nerve cord of *Terebellides* fuse to form one axon extending posteriorly. According to Dehorne (1935), the single large axon of *Lanice* is a syncytium connected with many large nerve cells.

Sabellariidae. A detailed study of the giant axons of sabellariids has not been undertaken, but it would appear that they are as well developed in

According to McIntosh two giant axons, entering the nerve cord from the oesophageal connectives, fuse together in segment VII to form a single giant fibre extending to the posterior end of the animal. The especially large nerve cells in the supra-oesophageal ganglia of *Magelona* (McIntosh, 1878) may be worthy of investigation as the source of these giant axons.

Sabellidae. There has been general agreement that giant nerve fibres attain particularly large

sizes in this family and that they occur in all species. They consist, in general, of very large fibres which extend the entire length of the nerve cord. Two separate patterns can be distinguished, however, which are related to the configuration

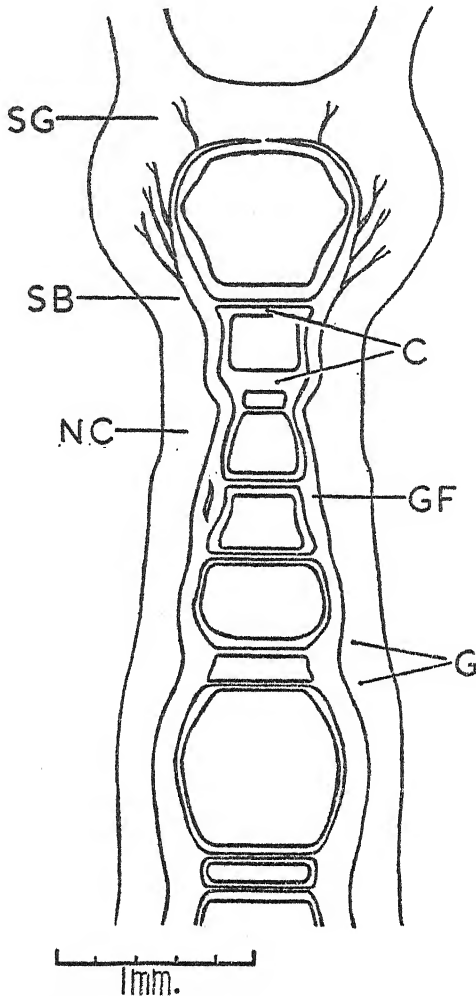


FIG. 25. RECONSTRUCTION OF THE ANTERIOR CENTRAL NERVOUS SYSTEM OF *SABELLA PAVONINA*

Somewhat diagrammatic. SG, supraoesophageal ganglia; SB, suboesophageal ganglion; NC, nerve cord; GF, giant axon; G, cord ganglia; C, commissures (original).

of the nerve cord. In the sabellids proper (Sabelinae, Fabriciinae) the nerve cord is double and conforms to the typical ladder pattern. A large fibre lies in each half of the nerve cord (*Spirographis*, *Sabella*, *Branchiomma*, *Chone*, *Euchone*, *Bispira*, *Laonome*; Claparède, 1873; Cunningham,

1887; Evenkamp, 1931; McIntosh, 1877, 1885, 1918, 1923; Meyer, 1887, 1888; Pruvot, 1885; Saint Joseph, 1894; Spengel, 1881; Thomas, 1940). In *Spirographis* the two fibres are connected together in the commissures of the thoracic region (Claparède, 1873), and in *Sabella* cross anastomoses occur between the two fibres in the two commissures of each segment of the body (Nicol, 1947). Moreover, in *Sabella*, *Spirographis*, *Branchiomma*, and *Euchone* the giant axons extend through the oesophageal connectives into the supraoesophageal ganglia. Axon diameters are: *Bispira volutacornis* Montagu, 120 μ ; *Sabella pavonina* Savigny, 120 μ –200 μ ; *Spirographis spallanzanii* Viviani, 120 μ ; *Branchiomma vesiculosum* Montagu, 135 μ (Brunotte, 1888; Claparède, 1873; Cunningham, 1887; Evenkamp, 1931; Nicol, 1948; Saint Joseph, 1894) (Figs. 15, 16, 23 and 25). In the Eriographinae (=Myxicolinae, *Myxicola*), the nerve cord is double for short stretches in the anterior thoracic region and consists of a single strand posterior to this region (Fig. 24). In conformity to this arrangement there are two giant fibres in the first few setigers, where they interconnect by transverse anastomoses, and a single large fibre in the posterior thorax and abdomen. The giant fibres also extend into the supraoesophageal ganglia, as in the other two subfamilies (Claparède, 1870, 1873; Cunningham, 1887; Friedländer, 1889; McIntosh, 1877, 1923; Meyer, 1887, 1888; Pruvot, 1885; Wawrzik, 1892). In a recent investigation of *Myxicola infundibulum* Montagu, it has been shown that the giant axon arises from two large nerve cells in the supraoesophageal ganglia (Fig. 24). From each of these cells a large axon extends down one oesophageal connective and the two axons fuse in the suboesophageal ganglion to form the giant fibre (up to 1.7 mm. in diameter) lying in the nerve cord. Moreover, the giant axon is in protoplasmic continuity with many small nerve cells along the entire length of the cord and gives rise to several branches entering the peripheral nerves in each segment. The peripheral branches themselves are very large (up to 85 μ in diameter) and directly innervate the relatively massive longitudinal musculature of the animal (Figs. 17, 24, 26). A small species, *M. aesthetica* Claparède, appears to have essentially the same structure (Nicol, 1947; Nicol and Young, 1946). In general, the giant axons of sabellids are surrounded by a distinct cellular and fibrous sheath (Claparède, 1873; Evenkamp, 1931; Friedländer,

1889; Wawrzik, 1892). Friedländer (1889) stated that the giant axon sheath of *M. infundibulum* "stained" slightly with osmium tetroxide, and Nicol (1948) detected a thin fatty layer, which coloured with Sudan black, next to the giant axon. *Serpulidae*. In this family, which is closely related to the Sabellidae, axons in the nerve cord are equally greatly hypertrophied. A pair of giant fibres has been found in nearly all forms examined, namely *Protula*, *Serpula*, *Pomatoceros*, and *Hydroides* (Claparède, 1873; Cunningham, 1887; McIntosh, 1877, 1885, 1918, 1923; Meyer, 1887,

not been confirmed, and it is probable that giant axons are absent in the Syllidae (Malaquin, 1893; Perrier, 1897). Vejdovský (1878) is the only author who has described a giant fibre in *Tomopteris* (Tomopteridae). McIntosh (1925), on the other hand, considered that they are absent in this family. Since tomopterids are small free-swimming pelagic forms, it would be expected that they would lack the defensive mechanisms available to tubicolous and burrowing species. *Polyodontes* (Polyodontidae) and *Goniada* (Goniadidae) appear to have two inconspicuous giant axons in

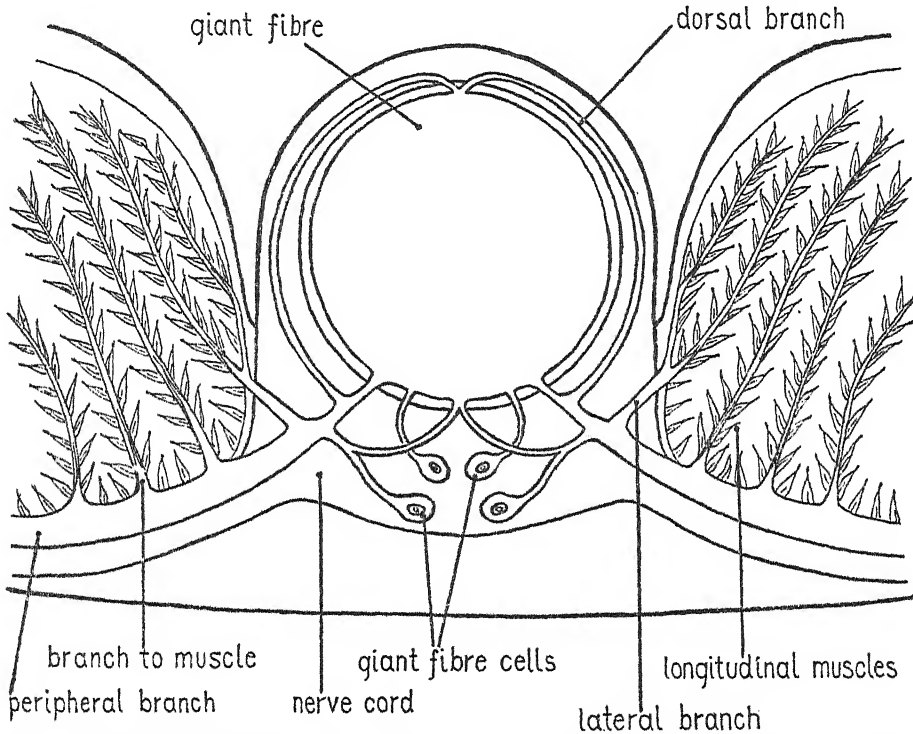


FIG. 26. DIAGRAM OF THE NERVE CORD, GIANT FIBRE AND BRANCHES OF *MYXICOLA INFUNDIBULUM*, AS SEEN IN TRANSVERSE SECTIONS

1888; Pruvot, 1885; Thomas, 1940; Treadwell, 1891). Each half of the nerve cord contains a large nerve fibre, which extends from the suboesophageal ganglion to the posterior end of the body. According to Claparède (1873), the giant fibres of *Protula intestinum* L. extend into the oesophageal connectives as well.

Other polychaete families. The occurrence and arrangement of giant axons in other families of polychaetes are based on less extensive evidence. Claparède (1868) described a large central fibre in the nerve cord of *Syllis vittata* Grube, but this has

the nerve cord (Ehlers, 1868; McIntosh, 1877, 1885). In the Disomidae, Allen (1904) found two large fibres in the nerve cord of *Poecilochaetus serpens* Allen, each about 82μ in diameter. Ashworth (1901) believed that they are absent in *Scalibregma inflatum* Rathke (Scalibregmidae), and McIntosh (1923) could find none in *Cistenides* (= *Cystarides*) *hyperborea* (Pectinariidae). They are apparently absent in certain cirratulids (*Cirratulus cirratus*, O. F. Müll. (Cunningham, 1887)), or are small in size (*Cirriformia* (= *Audouinia*) (Claparède, 1873; McIntosh, 1923); *Cirratulus*

(Michel, 1898)). McIntosh (1923) has described, however, a large nerve fibre lying dorso-medially in the nerve cord of *Dodecaceria concharum* Oersted (Cirratulidae). Giant fibres are present in *Stylarioides* (Flabelligeridae), in which Cunningham (1887) found a giant fibre in each half of the nerve cord. They are inconspicuous or absent in *Phyllodoce* (Phyllodocidae) (Cunningham and Ramage, 1888; Michel, 1899). McIntosh (1885) has described a single giant axon in species of

fibres, which he compared with the giant axons of other chaetopods. Two kinds of large axons occur in *Myzostoma*: (1) groups of longitudinal fibres extending through the ganglionic mass; (2) 6-7 pairs of large unicellular axons, each of which springs from a large nerve cell, decussates with a corresponding fibre, and enters a peripheral nerve. The significance of these neurones is obscure.

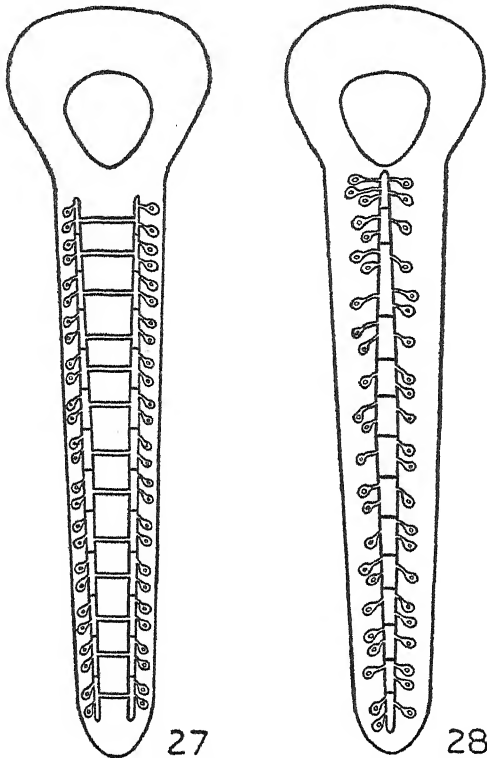
Oligochaeta

Following Claparède's original description in 1861, numerous investigations have been made of the giant axons of the Oligochaeta. Since the descriptions are more extensive for giant axons of the Lumbricidae, this family will be considered first, followed by a discussion of the giant axons of other species of oligochaetes.

Giant axons of the Lumbricidae. There is common agreement that three giant fibres are present in the dorsal region of the nerve cord of the earthworm (*Lumbricus* and related genera) and that they extend throughout the greater part of this structure (Leydig, 1864a; and subsequent authors). Stough (1926) found that supernumerary giant fibres sometimes occur: these arise from the normal fibres and either arborize in the neuropil or rejoin the giant fibres again (Figs. 18, 27, 28).

Leydig (1864a) stated that the three giant fibres are generally of the same size; but later workers have found that the median fibre is larger than the lateral ones (Vejdovský, 1884; Vignal, 1883). The fibres are small in the anterior nerve cord, increase in size in the middle and posterior regions of the body, and diminish again at the extreme posterior end (Cerfontaine, 1892; Claparède, 1869; Friedländer, 1888). Stough (1926) found that the lateral giants, which are small at the two ends of the nerve cord, become almost as large as the median giant in the middle body region and that, on the average, the sum of the diameters of the two lateral fibres equals the diameter of the median fibre.

Friedländer (1888, 1889, 1894) gave the first description of the nerve cells of these fibres, and he showed that they are syncytial structures; further details were given by Cerfontaine (1892), Keyl (1913), Stough (1926), and Smallwood and Holmes (1927). There are two to six large nerve cells and a number of smaller cells that connect either with the median or with the two lateral fibres in each segment. Stough (1926) found a considerable amount of fusion of the processes of the cells before they reach the median giant axon.



FIGS. 27, 28. DIAGRAMS OF THE PAIRED LATERAL GIANT AXONS AND THE SINGLE MEDIAN GIANT AXON OF LUMBRICUS
(Sources cited in text)

Amphinomidae (*Hermodicæ* and *Eurythoë*). Perrier (1897) stated that there are no giant fibres in the Opheliidae, but several small fibres have been described repeatedly in various species of this family (Cunningham, 1887; Kükenthal, 1887; McIntosh, 1877, 1923; Meyer, 1882; Vejdovský, 1878). Such fibres, although noticeably larger than the other nerve fibres in the cord, are still of quite small size.

Myzostomida. In this aberrant and parasitic group Nansen (1887) has described large nerve

The question of anastomoses among the dorsal giant axons of the earthworm has been a controversial one for a long time, and it is only recently that this aspect has been clarified. Claparède (1869) denied that the giant fibres of the earthworm anastomose with one another, but Leydig (1864a, 1864b), Friedländer (1888, 1894), Cerfontaine (1892), Krawany (1905), and Stough (1926) have found connexions between the giant fibres. Cerfontaine and Stough, in particular, have shown that the two lateral giants are connected by a transverse anastomosis in each segment and are independent of the median axon. Recent physiological studies have confirmed the anatomical descriptions of Cerfontaine and Stough. The latter author (1930) discovered, as a result of cutting either the median giant or the two lateral giants, that these structures possess functional peculiarities distinguishing them from one another. He concluded that the median fibre conducts posteriorly while the two lateral fibres conduct anteriorly; fusion of the lateral and median fibres is clearly impossible on this basis. Eccles, Granit, and Young (1933), from a study of the action potentials recorded from the nerve cord, showed that the giant fibres can conduct equally well in both directions when stimulated electrically. These authors found two large spike potentials differing in amplitude and velocity, the smaller spike being transmitted with a velocity greater than the larger spike potential. They suggested that their results could be explained on the basis of these anatomical facts: that the two lateral fibres are connected together by transverse junctions and conduct as a unit and that their combined cross-sectional diameter is about equal to that of the median fibre. They concluded that the smaller, faster spike is conducted by the median giant and the larger, slower spike by the two lateral giants. This work has been extended by Bullock (1945) who found that the smaller and faster spike was abolished by sectioning the median fibre, and that the two lateral fibres conduct as a unit independently of the median giant axon. Rushton's conclusions (1945a) were similar. He was successful in cutting all three giant axons, moreover, and demonstrated that the faster wave dropped out after section of the median giant and the slower wave after section of both lateral giants; alternate hemisection of the cord, right and left, increased the latent period of the lateral fibre response without abolishing it. He concluded from this evidence, that the lateral

fibres are connected with each other at least once in every ten segments.

Perhaps the most peculiar feature of the giant axons of the earthworm is the fact that they are not continuous structures but are subdivided in each segment by oblique septa or partitions. These septa were probably first observed by Leydig (1886), and they have been described and figured subsequently by Stough (1926) and Young (1936). Stough pointed out that they provide a large area of contact between the axonic segments of two consecutive ganglia and suggested that they contain a layer of myelin since they stain with osmic acid. Smallwood and Holmes (1927) and Bullock (1945), by the use of silver stains, have demonstrated that the neurofibrillae are interrupted at these places of junction; and Taylor (1940), in a study of sheath birefringence, found that the optical properties of the segmental partitions of the giant fibres are similar to those of the myelinated axon sheath, indicating similarity in their composition and ultrastructure.

The giant axons are surrounded by a relatively thick fibrous sheath composed of concentrically arranged fibrils and containing small nuclei of supporting cells (Claparède, 1869; Leydig, 1864a; Nansen, 1887; Vignal, 1883; and others). Moreover, the sheath is lamellated and seems to include a more homogeneous inner layer closely applied to the giant axon. It has already been stated that this sheath is myelinated (Claparède, 1869; Friedländer, 1888; Schultze, 1879; Stough, 1926; Vejdoský, 1884, 1892; and others). Taylor (1940), from birefringence data, concluded that the sheath ultrastructure is qualitatively similar to that of frog sciatic nerve fibres, with lipid molecules oriented radially and protein molecules tangentially. He found that the relative sheath thickness increases with decrease in fibre diameter below 40μ and that zero birefringence occurs at fibre diameters of 10μ – 12μ , some of the fibres in this range being metatropic.

No clear description of the branches and afferent connexions of the giant fibres exists. Bullock (1945), from an oscillographic study of the giant fibres of *Lumbricus*, stated that "they are apparently on the efferent side of the reflex arc, but are not probably the final common path." Since all these fibres conduct in both directions, as the result of electrical as well as natural stimulation, Bullock suggested that they bring about different muscular responses. That is, the fibres are con-

nected to different efferent neurones, anterior stimulation leading to one type of response by way of the median fibre, posterior stimulation to another type of response by way of the lateral fibres. Friedländer (1888) saw some type of connexion between ventral branches of the median fibre and fibres extending into the peripheral nerves; Haller (1889) and Cerfontaine (1892) described branches entering the peripheral nerves. Smallwood and Holmes (1927) mentioned motor branches, but it is difficult to determine whether these authors were referring to branches of the giant fibres or to separate motor neurones. A further investigation is required of this difficult subject before conclusions are possible.

Somewhat more is known of the afferent paths to the giant fibres. Stough's conclusion (1930) has been mentioned earlier, namely, that the median giant conducts posteriorly, and the lateral giants anteriorly, as the result of tactile stimulation. Bullock (1945) and Rushton (1946), from oscillographic records, have shown that the median giant must be connected to sensory neurones in the anterior region, and the lateral giants to sensory neurones in the posterior region of the body. In an intermediate, central region afferent neurones reach all three giant fibres. According to Smallwood (1930) and Smallwood and Holmes (1927), incoming sensory fibres, on entering the neuropil, establish synaptic relations with the giant fibres either directly or through branches of the giant fibre cells.

Rushton (1945b) has pointed out that the form of startle response shown by the earthworm in nature is more complex than that revealed by electrical studies in the laboratory. On a rough surface, where the setae can grip, the responses are of two kinds: when the region anterior to the fortieth segment is touched, the tail is anchored and the head withdrawn; when the posterior region is touched, the head is fixed and the tail brought forwards. The retraction associated with the median axon is accompanied by a characteristic flattening of the tail and a directing of its setae forwards. This reaction is well adapted to grip the sides of the burrow when the anterior end is emergent. Moreover, the presence of the tail in the burrow causes some switching over of the giant fibre systems. If a worm, protruding from its burrow, is grasped behind the fortieth segment, it gives the median fibre response. These several

reactions reveal a considerable diversity of central connexions.

Besides the three dorsal giant fibres, a pair of smaller ventral giant axons has been described in the earthworm (Friedländer, 1888). They are surrounded by an osmiophilic sheath (Stough, 1926) and are divided by transverse septa like the dorsal giants (Smallwood and Holmes, 1927). Nerve cells in the ventral region of the cord send processes to these ventral giant fibres, to the neuropil, and into the peripheral nerves (Smallwood, 1930; Smallwood and Holmes, 1927). Bullock (1945) picked up action potentials smaller than those of the dorsal giants and suggested that these might be due to the ventral giant axons.

Giant axons of other Oligochaetes. Much less is known of the giant fibres of other families of oligochaetes. Frequently three are present, as in the earthworm, but in the Megasclecididae some species constantly have four of these axons (Beddard, 1883; Keyl, 1913; Vejdovský, 1878), and in some species of the Naididae (*Nais*) and Enchytraeidae (*Pachydrilus*, *Enchytraeus*), two axons present anteriorly fuse together to form a single axon extending posteriorly in the nerve cord (Leydig, 1864b; Michaelsen, 1886; Vejdovský, 1878). The giant axons of the Glossoscolecididae appear to resemble those of the Lumbricidae (Benham, 1887; Friedländer, 1894; Perrier, 1874; Vejdovský, 1878). Hönig (1910) found three giant axons in *Criodrilus*; these appear to be connected with nerve cells throughout their course in the nerve cord. Keyl (1913) found ventral processes arising from the three giant fibres of *Alma nilotica* and, with more or less certainty, traced these processes to nerve cells lying in the ventral region of the nerve cord.

GIANT AXON PATTERNS IN THE ANNELIDA

The descriptions of giant axons of annelids, although far from complete, show that these structures display the greatest diversity and a baffling complexity. They differ so greatly from one another in different families and even in different genera of the same family that it is difficult to establish any anatomical categories in which they can be classified, even for convenience of description and for summary of their common characteristics. The following arbitrary division of giant axons into intrasegmental and intersegmental giant axons is presented for the purpose of discussion.

Intrasegmental giant axons

In many species of polychaetes, giant axons extend long distances in the nervous system, either throughout the length of the nerve cord or through many segments. In a few species, however, nerve fibres of exceptionally large size are confined to single segments of the animal; such fibres always enter the peripheral nerves. The clearest examples of this arrangement are afforded by *Euthalenessa dendrolepis* (Sigalionidae) and *Lepidasthenia elegans* (Polynoidae), described above. In these two species a process of a large nerve cell in each segment crosses the cord and passes out into the body wall. Similar intrasegmental fibres that enter the peripheral nerves occur in *Aphrodita* and *Hermione*, but their cell bodies are unknown; *Ichthyotomus* likewise possesses intrasegmental unicellular giant axons, described above. In *Neanthes virens*, a pair of cells in each neuromere gives rise to two fibres which fuse together and then establish contact with a pair of intersegmental giant fibres before passing into the peripheral nerves on either side of the nerve cord. This arrangement of intrasegmental giant axons is very similar to that occurring in the crayfish and the prawn (Holmes, 1942; Johnson, 1924; Wiersma, 1947), where peripherally directed motor axons, which arise from the anastomosis of two neurones, synapse with giant fibres running through the nerve cord. As in the crayfish, the intrasegmental giant fibres of *Neanthes* are probably motor axons which carry impulses from the lateral giant fibres to the longitudinal muscles. Eisig (1906) regarded the intrasegmental giant axons of *Ichthyotomus* as sensory neurones. As a general rule, however, afferent fibres in the Annelida usually arise peripherally at the body surface, and it is probable that these large peripheral fibres in *Ichthyotomus* are motor axons. They are probably motor axons in the Aphroditidae, Sigalionidae, and Polynoidae as well; but there is no indication that they bear any relation to the intersegmental giant fibres in *Euthalenessa* and *Lepidasthenia*. In fact, intersegmental giant axons do not occur at all in *Aphrodita* and *Hermione*, where intrasegmental giant fibres appear to be present (Cunningham, 1887; Rohde, 1887).

Intersegmental giant axons

Giant axons that extend long distances in the central nervous system are found in nearly all oligochaetes and in many polychaetes and, in

terms of size, are enormously developed in species of the Eunicidae, Lumbrineridae, Onuphidae, and in the Sabelliformia. They are hypertrophied also in the sedentary Sabellariidae. Unfortunately, few actual measurements of these structures are available; most authors have merely recorded the fact that they are enormous, large, medium-sized, or small in any particular species.

Myxicola infundibulum has the largest nerve fibre known in the animal kingdom: in some specimens it reaches a diameter of over 1.5 mm. In *Sabella* and *Branchiommata* the fibres have diameters up to 200 μ . These three species are about 15 cm. long. In smaller sabellids, 3 cm. long or less, the giant axons are correspondingly smaller. In *Myxicola aesthetica*, for example, a species about 2 cm. long, the maximal diameter of the giant axon is about 40 μ ; and in *Laonome kroyeri*, about 3 cm. long, the fibres are 70 μ –80 μ in diameter (Evenkamp, 1931). In the Disomidae (*Poecilochaetus serpens*) they are about 83 μ (Allen, 1904), and in the Arenicolidae (*Arenicola grubei*) they are 100 μ –300 μ in the living state, according to Gamble and Ashworth (1900). (These dimensions certainly are excessively large. St. Joseph (1894) gives a diameter of 29 μ for the giant axons of *A. marina*, and in their illustrations Gamble and Ashworth depict giant axons with diameters of 22 μ –43 μ .) They are small in the Nephtyidae, as, for example, in *Nephtys caeca*, 8 μ –14 μ (Schack, 1886). Several authors have stated that they are especially large in some spionids (Cunningham, 1887; McIntosh, 1877); but no representative measurements are available. Jacobi (1883) gives diameters of 22 μ and 30 μ for *Polydora ciliata* and *P. quadrilobata*, respectively, and Claparède (1868) gives 48 μ for *Nerine cirratulus*. Claparède (1868) and Ashworth (1909) have stated that the giant fibres of *Halla parthenopeia* (Lysaretidae) are 8 μ to 40 μ in diameter. The "giant" axons of the Glyceridae are, in fact, rather small, being about 16 μ –29 μ in *G. convoluta* (Nicol, 1947; St. Joseph, 1894). The measurements available are too few to permit many correlations to be drawn between the size of the animal and the size of the axons or the function of the fibres, but it is probably significant that they are well developed in many sedentary, tubicolous, or burrowing species. They are large in all the sedentary Sabellariidae, Serpulidae, and Sabellidae, in the burrowing Arenicolidae and Disomidae, and in other polychaetes that have burrowing or tubicolous habits, as, for example, *Eunice*, *Hyalinoecia*,

and *Nereis*. On the other hand, giant axons appear to be absent in short and broad forms physically incapable of retraction by end-to-end contraction, as, for example, *Aphrodita*, and in the small and actively swimming syllids and tomopterids. Among the oligochaetes, giant nerve fibres are relatively enormous in the tubificid *Branchiura sowerbyi* Beddard (Stephenson, 1912). Keyl's (1913) measurements for the giant axons of *Lumbricus terrestris* (middle segments) are: median fibre, $90\mu \times 114\mu$; lateral fibres, $50\mu \times 62\mu$; and for the posterior segments of *L. communis* (? = *Allolobophora caliginosa* Savigny), median fibre, 12.5μ ; lateral fibres, 7μ (Keyl, 1913).

In the Sabellidae giant axons are relatively large in all species examined, and their absolute size is restricted only by the size of the animal: obviously a species like *M. aesthetica*, 1 mm. in diameter, must contain a smaller giant axon than its larger relation, *M. infundibulum*, in which this fibre attains a diameter of 1 mm. or more. These fibres also vary greatly in diameter in different parts of the nervous system. The giant axons of *M. infundibulum* and *M. aesthetica* are small in the supraoesophageal ganglia, increase in size in the oesophageal connectives, reach greatest diameters in the thorax, and taper off in the abdomen. Also, in *M. infundibulum*, the fibre changes greatly in diameter within each segment, bulging out in the centre of a segment and becoming constricted intersegmentally. Similar segmentally arranged constrictions and dilations have been noted in the polychaetes *Nerine cirratulus* (Spionidae) (Michel, 1899) and *Mastobranchus* (Capitellidae) (Friedländer, 1889); and in the oligochaete *Lumbriculus variegatus* O.F. Müll., the three giant axons are stated to be constricted at intervals (Vejdovský, 1878). Evenkamp (1931) found that the two giant fibres of *Laonome kroyeri* (Sabellidae) are very small in the oesophageal connectives, about 3μ , and then gradually increase in diameter to about 70μ – 80μ in the nerve cord. Claparède (1873) has stated that in *Spirographis spallanzanii* (Sabellidae) each of the two fibres is 35μ wide in the oesophageal connectives, increases to 100μ in the suboesophageal region, and becomes 180μ wide in the nerve cord. In *Eunice rousseaui* (Eunicidae), Keyl (1913) found that the giant fibre has a diameter of about 40μ in the suboesophageal region and increases posteriorly to about 100μ (mean figures). The fibre also varies considerably in shape in this species, being flattened later-

ally within the connectives and processes rounded within the ganglia. In *M. infundibulum* (Sabellidae), the giant axon increases greatly in diameter as the animal shortens, and probably a similar change in diameter occurs in the giant axons of all species that can contract.

It is definitely known that these axons extend throughout the nerve cord in all species of sabellids (and probably serpulids) that have been examined closely. They also run through most trunk segments in *Nereis* (Ehrenborg, 1898), *Arenicola* (Gamble and Ashworth, 1898), in *Mastobranchus* (Friedländer, 1889), in some polynoids and sigalionids (Rohde, 1887), in the malpadian *Chymenella* (Bullock, 1948), and in all oligochaetes that possess these nerve fibres. In some species they extend into the supraoesophageal ganglia as well, namely, in *M. aesthetica* and *Spirographis* (Claparède, 1873), *Sabellia* (St. Joseph, 1894), *Branchiomma* (Brunotte, 1888), *Branchione papillosa* (Evenkamp, 1931) and probably other sabellids, in *Neanthes* (Ehrenborg, 1898), and in *Euthalenessa dendrolepis* (Rohde, 1887). In other species the giant axons may have a more restricted course and extend through part of the nerve cord only. In the polynoid *Lepidasthenia elegans* they disappear about 6 segments from the posterior end, but it is possible that they continue further caudally than this level, as some fibres that are difficult to differentiate (Rohde, 1887). However, there are certain postero-anterior giant fibres in *Lepidasthenia elegans* that arise from nerve cells lying between segment 16 and the third last segment; these fibres obviously have a very restricted course. In *Halloporthus* the anterior nerve cells of the giant fibres lie in the first few ganglia: only the largest fibres reach the posterior end of the animal; the others successively taper off and disappear in the neuropil at more anterior levels (Ashworth, 1909).

UNICELLULAR AND MULTICELLULAR GIANT AXONS AND NEURONAL INJECTION

Giant axons in the Annelida can be divided quite sharply into the two categories of unicellular and multicellular giant axons, according to the number of cell bodies joining them. Only the intersegmental giant axons will be considered.

Unicellular giant axons

In a few species it is known that the giant axons are unicellular, each fibre arising from a single

nerve cell and being anatomically independent of the other giant axons. The best known case is *Halla*, but a similar arrangement occurs in *Aglaurides* (Ashworth, 1909). In *Halla* (Lysaretidae) each giant fibre is the process of one nerve cell and remains separate from the other giant fibres in its course through the nerve cord. Unicellular giant fibres also occur in the Sigalionidae (Rohde, 1887). In *Euthalenessa dendrolepis* there are five giant axons, each of which arises from a cell in the anterior nerve cord and extends towards the posterior end of the body. Large nerve cells also occur in most segments behind the sixteenth, and the single process of each of these cells runs anteriorly in the nerve cord. Antero-posterior giant fibres arising from single nerve cells also occur in *Sigalion squamatum*.

Multicellular giant axons

There are enough descriptions now available to show that multicellular giant axons are of widespread occurrence in the Annelida. The classical example is the earthworm (*Lumbricus* and allied genera), in which the median and the two lateral giant fibres receive the processes of nerve cells throughout their length. The arrangement is complicated in these animals by the fact that the three giant axons are each divided into segments by transverse septa in each ganglion. But, since there are several cells in each ganglion connected with the giant axon, the giant axon segments are themselves syncytia (Cerfontaine, 1892; Friedländer, 1888; Smallwood and Holmes, 1927; Stough, 1926; Young, 1936). Multicellular giant axons that receive the processes of nerve cells in each segment also occur in the capitellid *Mastobranchus* (Friedländer, 1889), in the maldanids *Clymenella* and *Clymene* (Lewis, 1898), and in *Arenicola* (Gamble and Ashworth, 1898). Transverse septa have not been described in these forms. In the sigalionid *Euthalenessa*, one giant axon arises from a pair of cells in the supraoesophageal ganglia (Rohde, 1887). Finally, in *Myxicola* the giant axon arises from two nerve cells in the supraoesophageal ganglia and, in addition, is connected with at least ten nerve cells in each segment.

Axoplasmic fusion is a very difficult matter to prove when the neurones concerned are rather small. Although many authors have described multicellular axons in the Annelida, there are few descriptions which actually present evidence that

complete fusion of axoplasm occurs, either between different giant axons or between a giant axon and several nerve cells. In *Neanthes virens*, Hamaker (1898) stated that the intrasegmental giant axons undergo complete anastomosis in the centre of the cord, with fusion of neuroplasm and probable exchange of neurofibrillae. Lewis (1898) claimed that in *Clymenella* and *Clymene* the axoplasm of the cell processes fuses with that of the giant axon. It is impossible to prove by cutting the nerve cord that the giant axons of the earthworm are multicellular structures, since the giant fibres are segmental in this animal, and degeneration, if it occurred, would not be expected to extend past the septal barrier in each segment. In fact, after transection, the giant axons do not degenerate but actually regenerate and grow together from their cut ends (Bovard, 1918b; Hall, 1921). *Myxicola infundibulum* appears to be the only species of the Polychaeta in which the giant axon has been cut in order to determine if either of the separated pieces will degenerate; and evidence for the multicellular origin of that nerve fibre has been obtained by this means (Nicol 1948; Nicol and Young, 1946).

Fusion of neurones is not unknown in the vertebrates. Harrison (1913) has described anastomosis of nerve fibres in tissue culture of frog embryo tube; and Speidel (1935) found that growing tips of nerve fibres in the living tail fin of frog tadpoles fuse with one another, though he qualified this description by stating that fusion is between the outer more "plastic" protoplasm and does not involve the inner, more "viscous" axes of the fibres. Multicellular giant axons also occur in other invertebrate phyla. The two medial giant axons of the prawn are probably syncytia, since they fail to degenerate after section (Holmes, 1942). Young (1936b) has shown that in decapod cephalopods each of the giant axons in the stellar nerves probably arises from several hundred nerve cells in the stellate ganglion.

It is not improbable that the syncytial nature of these giant axons is concerned with the necessity of maintaining such large masses of axoplasm. In *Halla* the unicellular giant fibres are about 8μ – 40μ in diameter, and their cell bodies have diameters of 30μ – 150μ (Ashworth, 1909; Claparède, 1868). *Arenicola* contains one to three interconnected giant axons, 22μ – 43μ in diameter, which are connected to one or two nerve cells (40μ – 80μ in diameter) in each segment (Ashworth, 1904;

Gamble and Ashworth, 1898). In the earthworm (*Lumbricus*), where the giant axons may have diameters up to 163μ , five or more cells (the exact number is unknown) join a section of the giant axon in each segment. These cells have diameters of 13μ – 24μ (Keyl, 1913). In *Myxicola infundibulum* there are ten or more nerve cells joining the giant axon in each segment. The giant axon in this species has a diameter up to 1.7 mm., and the giant fibre nerve cells have a mean diameter of 25μ (Nicol, 1947, 1948). In a worm having a giant axon 91 mm. long and 740μ in mean diameter and connected with 1300 nerve cells, the giant axon would have a volume of $39,545 \times 10^6 \mu^3$, and the giant fibre cells a volume of $7.9 \times 10^6 \mu^3$, a ratio of 4900:1. This ratio is in sharp contrast to calculations advanced for mammalian neurones. The axon of a rhesus anterior horn motoneurone 25 cm. long and 8μ in diameter, has a volume of $12.5 \times 10^6 \mu^3$; its cell body, $50\mu \times 50\mu \times 40\mu$ in diameter, has a volume of $50,000 \mu^3$, a ratio of 250:1 (Bodian and Mellors, 1945). For a human spinal ganglion neurone, having an axon 1 m. long and 12μ in diameter, and a cell body 120μ in diameter, estimated volumes are $108 \times 10^6 \mu^3$ and $864,000 \mu^3$, respectively, a ratio of 125:1 (Heidenhain, 1911). These figures for annelids suggest that morphogenetic factors of undetermined nature are operating to increase the size of the cell body or to multiply the number of cells as the axon enlarges, in order to maintain unaltered the ratio of cell body to axoplasm. Nerve cell volume, theoretically, can be increased by either mechanism, that is by an increase in size of the cell or by an increase in the number of cells; and, in actual fact, it does seem to have occurred by both methods (compare *Halla* and *Myxicola*). It is also possible that it is of some advantage to an animal, like an annelid, that can undergo autotomy and regenerate a region of the body that is lost, to have a multicellular axon that does not suffer degeneration when cut; the principal defence mechanism of the animal would thus remain unimpaired during the period of regeneration.

FUSION OF GIANT AXONS

In many annelids where more than one giant axon is present, it is known that the several axons fuse with one another to form an anastomosing network in the nerve cord. Claparède (1873) was probably the first person to observe such interneuronal fusion among giant axons; he found that

the two giant fibres of *Spirographis* (Sabellidae) anastomose with one another in the suboesophageal ganglia and commissures. Friedländer (1888, 1889) subsequently showed that the two lateral giant fibres of *Lumbricus* (Oligochaeta) and *Mastobranchius* (Capitellidae) are connected in each segment by anastomoses. In *Arenicola* (Arenicolidae) the three giant fibres anastomose with one another in each ganglion (Bullock, 1948; Gamble and Ashworth, 1900). In *Neanthes virens* (Nereidae) the intrasegmental axons of two nerve cells fuse together in each segment (Hamaker, 1898); and in the sigalionid *Euthalenessa dendrolepis* two axons arising from nerve cells in the supraoesophageal ganglia unite in the suboesophageal region (Rohde, 1887). Fusion of giant axons has been described also in the Magelonidae and Ampharetidae, and the phenomenon is of common occurrence in several families of oligochaetes. In *Myxicola* (Sabellidae), it has been found that the two giant axons in the supraoesophageal ganglia and oesophageal connectives fuse together in the suboesophageal ganglion to form a single enormous axon, which subdivides and fuses several times in the thorax and in the posterior abdomen. In *Spirographis* and *Sabella* the two giant axons fuse with one another in the suboesophageal ganglia (Claparède, 1873; Thomas, 1940), and in *Sabella*, at least, they are joined together by transverse anastomoses in each of the commissures connecting the two pairs of ganglia in each segment (Nicol, 1947).

Both Hamaker (1898) and Young (1939) have commented on the utility to the animal of these occurrences of interaxonic fusion. In the squid and cuttlefish it ensures that impulses set up on either side of the animal will produce a contraction of the whole mantle and not of just half the sack, as might occur if the two axons were separate. In crustaceans, interaxonic fusion produces a symmetrical contraction of the longitudinal muscles of both sides of each segment as the result of an impulse in any one of the four intersegmental giant axons (Wiersma, 1947). Possibly the segmental motor axons in *Neanthes* (Nereidae) have a similar function with respect to the paired lateral giant fibres. Interaxonic connexions between paired giant axons are probably of considerable significance in the annelids, because in these animals there are no organs specially developed for lateral steering. Alterations in lateral displacement are effected by directing the anterior or posterior part of the body to either side through differential con-

traction of different muscle groups. A giant fibre impulse, in consequence, that stimulated only one half of the body musculature would result in a certain amount of curvature of the body during quick contraction and not in a symmetrical uniaxial shortening of the entire body.

GIANT AXONS OF ANNELIDS AND THE NEURONE THEORY

The discrepancy that exists between the criteria of a neurone, according to the neurone theory, and the occurrence of interneuronal fusion in invertebrate giant axons has been considered by several authors. Instancing the polychaetes, Lewis (1898) and Hamaker (1898) believed that the syncytial giant axons constitute an exception to this rule, as they obviously do if histological criteria alone are employed. Young (1939) has presented a synthesis of these divergent facts for the giant fibres of invertebrates and has pointed out that syncytial giant axons actually strengthen the neurone hypothesis if such axons are regarded as functional entities. In the words of this author: "When axons are fully fused they always work together, impulses set up anywhere in them spreading over the whole continuous neuroplasm"; and again: "In every case where the complete fusion occurs the axons are ones which must always work together during the life of the animal." Impulses within such fused axons, however, are prevented from indefinite spread throughout the remainder of the central nervous system by synapses between them and other neurones. Such a concept obviously has equal validity for the giant axons of the annelids. Impulses set up anywhere in a syncytial giant axon are propagated throughout the rest of that axon (*Myxicola*, *Lumbricus*), and the function of such fused neurones is to effect a unified response in which all the neurones contributing to the fused axon, as well as all the muscles supplied by the resultant syncytial fibre, work together during the life of the animal. As Young (1939) has observed, it is biologically desirable that an impulse in one of these fused axons should spread throughout its extent and is the result to be predicted in such cases on the basis of the neurone theory.

DEVELOPMENT OF THE GIANT AXONS OF ANNELIDS

The development of the giant axons should provide one of the most interesting aspects of this subject. These multicellular axons are such

curious structures that a knowledge of their combination during ontogeny is highly desirable. Unfortunately, although the subject has been broached several times, nothing is definitely known of this process yet. On the basis of the definitive structure of the giant axons, however, a few tentative suggestions are offered that may be of value as working hypotheses for investigations of the development of these nerve fibres.

Unicellular giant axons

Ashworth (1909) has presented some interesting facts concerning the development of the unicellular giant axons of *Halla parthenopeia* (Lysaretidae). He found that there is a progressive increase in the number and size of giant axon cells in anterior segments until a maximum is reached in specimens 30 cm.—40 cm. long, after which no further increase occurs. The development of these axons appears to present no features of peculiar neurological interest. It would seem that certain nerve cells in the anterior segments send axons through the nerve cord towards the tail and, as the animal increases in length, the cells and their processes gradually enlarge until maximal size is attained.

Multicellular giant axons

There is practically no information available concerning the development of multicellular giant axons in the Annelida. Vejdvoský (1892) stated that the giant fibres of *Rhynchelmis* (Oligochaeta) arise from large cells in the dorsal neuropil of the cord, but since he regarded these cells as neuroglial, and the giant axons themselves as supporting structures, his account is almost incomprehensible. Wilson (1889) merely noted that the giant fibres of the earthworm arise in the dorsal part of the neuropil.

Rohde's description (1887) of a bicellular giant axon in *Euthalenessa* (Sigalionidae) gives the simplest known example of a syncytial intersegmental giant axon in the Annelida and provides a basis for postulating how the other more complex giant fibres in chaetopods could originate. It is probable that the axon of each of the giant fibre cells in the supraoesophageal ganglia grows down the oesophageal connective and fuses with the corresponding fibre from the other side of the body in the suboesophageal region. The fused axon then grows posteriorly through the nerve cord. Young's observations (1939) on the fusion of the two first-order giant cells in the palliovisceral

ganglion of *Loligo* (Cephalopoda) are of some interest in this connexion. In post-embryonic specimens of *Loligo pealii* he found that fusion of the substance of the two axons was still incomplete and that the interaxonic bridge still showed signs of having been formed by the combination of two tubes, indicating its multiple origin. In *Myxicola* (Sabellidae) the arrangement of the giant axons is somewhat similar to that of the bicellular fibre of *Euthalenessa*, except that the two cell processes decussate without axonic fusion in the supraoesophageal ganglia and, in addition, the giant axon is connected with nerve cells throughout its length in the nerve cord (Nicol, 1948). It may be suggested that during the development of this species the giant axon originates as the processes of two cells in the supraoesophageal ganglia and that these processes grow back through the nerve cord. As the axons increase in size, they are brought into apposition by the union of the halves of the nerve cord and fuse together. But at those levels where the cord remains divided into two parts, a single axon remains in each half of the cord and these two axons anastomose with each other in the transverse commissures.

The nerve cells in the nerve cord of *Myxicola* show a segmental arrangement; the peripheral branches of the giant axon also show a segmental pattern, in that they are localized in the anterior and posterior regions of each segment (Nicol, 1948). It may be that intrasegmental motor axons, such as those that occur in the aphroditids and those that synapse with the lateral giants in *Neanthes* (Nereidae), actually anastomose with the giant axon in *Myxicola*. It is suggested that, during growth of the giant axon, processes of these intrasegmental motor neurones enlarge, and one branch joins the giant axon while the other enters a peripheral nerve. It is still more hypothetical to extend this picture of development to other sabellids with a ladder-like nerve cord, since the exact origin of the giant axons in the supraoesophageal ganglia has not been determined. Nevertheless, the arrangement of the giant axons in *Sabella* and *Branchiommia* is very similar to that of *Myxicola*, with the exception that an axon occurs in each half of the nerve cord and, in *Sabella* at least, the axons anastomose in the transverse commissures between the ganglia of the cord.

The giant axon of *Clymene* (Maldanidae) possibly develops in a similar manner. Each axon arises from a large cell in the anterior nerve cord

(Lewis, 1898). It is likely that the processes of these two cells grow posteriorly through the nerve cord, fuse with one another and with neurones in each segment, the final structure being a syncytium.

On the basis of an explanation of this nature it is difficult to visualize how the giant fibres of *Nereis* and *Lumbricus* could develop, since these axons are subdivided by transverse septa in each ganglion. It is possible that the transverse septa arise secondarily and divide a continuous axon into short units. There is ample evidence from vertebrate neurology, however, to show that each axon arises as an outgrowth from a nerve cell and that its cytoplasm remains continuous with that of the nerve cell; connexions with other cells are made secondarily by synaptic contact at surfaces. It is more in harmony with these ideas to regard the annelid segmented axons as arising from intrasegmental neurones in each segment, the processes of these cells enlarging and extending longitudinally through each neuromere. At the anterior and posterior borders of each neuromere axons of separate segments would meet and synapse with one another, forming a chain of giant axon units which extends throughout the nerve cord. It is interesting that Vejdvoský (1892) claimed that the giant axons of *Rhynchelmis* arise from special cells in each segment and that the separate giant axons then fuse together longitudinally. However, since Vejdvoský believed the cells and giant fibres to be neuroglial or supporting structures, his descriptions need to be confirmed by a neurological investigation.

RELATIONSHIP OF THE GIANT AXONS OF DIFFERENT POLYCHAETE GROUPS

It has been suggested that giant axons have arisen independently on several occasions in the Invertebrata, namely, in cestodes, nemertines, annelids, crustacea, and cephalopods, and also in the protochordates and lower chordates (Prosser, 1946). This is a reasonable assumption, since the groups mentioned are so distantly related and the patterns of giant axons are so distinct from one another. Even within the Annelida, however, the giant axons show a great deal of variation, as can be seen from the preceding descriptions, and it is difficult to determine common or intergrading characteristics that would reveal a common origin within the group.

In several families of the annelids the giant axons

are obviously similar within each family. The clearest example of this occurs in the Sabelliformia (Sabellidae and Serpulidae), but characteristic patterns can be discerned also within the Nereidae, Glyceridae, Arenicolidae, Eunicidae, and Sabellariidae. The pattern of giant axons in a number of families of the Oligochaeta appears fairly homogeneous, and it is likely that the giant fibres in this order have a common origin and that the differences represent variations of some basic neuronal arrangement ancestral and common to all groups. It is perhaps noteworthy that the only family of the Oligochaeta in which giant axons are absent is a specialized parasitic one, the Branchiobdellidae (Vejdovský, 1878). In contrast to this picture, it is striking that intersegmental giant axons appear to be absent in a number of free-living polychaete families (Syllidae, Tomopteridae) and are lacking in certain species of families in which they are well developed (Arenicolidae, Capitellidae).

In the face of this variability, it is difficult to establish any homologies until more information is obtained regarding the following problems: (1) the complete extent of the giant axons among the annelids (for example in the Ampharetidae and Glyceridae); (2) the anastomosis and fusion of separate giant axons (for example in *Lumbrineris* and many capitellids); (3) the nerve cells of the axons (for example, in *Eunice*, *Sabellaria*, serpulids); (4) the origin within the supraoesophageal ganglia (for example, of sabellids, serpulids, *Eunice*, glycerids); (5) the occurrence of transverse septa (*Nereis*). The weight of the evidence does suggest that giant nerve fibres have evolved independently on several different occasions in chaetopods, as different groups have become specialized for tubicolous or burrowing habits (compare, for example, the similar burrowing habits and body form of *Lumbricus* and *Arenicola*, and the similar tubicolous habits of *Hyalinoecia* and *Sabella*). On the one hand, these fibres have arisen from enlargement and sometimes fusion of single axons that have grown long distances in the central nervous system; on the other hand, by fusion or synapse of intrasegmental neurones at the boundaries of each neuromere. The Annelida, patently, are a very labile group, no better evidence for which can be found than in the diversity of respiratory mechanisms occurring in the Polychaeta. This diversity clearly is equalled by the heterogeneity of the giant nerve fibres, and further work may well provide a series of very interesting examples of

convergent evolution in the central nervous system of this phylum.

AXOPLASM OF THE GIANT NERVE FIBRES

A number of studies have been made of giant fibre axoplasm in the decapod Crustacea and Cephalopoda, but very little information is available regarding it for the Chaetopoda. Friedländer (1888) succeeded in squeezing out axoplasm from the giant fibres of the earthworm, and he believed that they contain a viscous water-soluble substance. The axoplasm of the giant nerve fibre of *Myxicola* is rather viscous and forms a jelly-like strand when squeezed out on a dry cover slip. Moreover, it retains its cylindrical form for about a minute before finally collapsing. The axoplasm is more of a gel than a sol, for although a small amount does escape from a perforation in the axon, flow of axoplasm never proceeds far enough to cause collapse and emptying of the axis cylinder. Since the axon of *Myxicola* alters so greatly in shape during movement of the body, the axoplasm must either be fluid enough to flow and undergo rearrangement during contraction and elongation of the body, or its viscosity must alter continuously during the life of the animal. The giant axons of the cephalopods *Sepia* and *Loligo* furnish an interesting comparison in this regard. Young (1934; 1936c) observed that when the giant axons of these animals are cut, axoplasm flows freely from the cut ends, and that this outflow continues for several minutes, accompanied by a general collapse of the sheath. Flaig (1947) has recently shown that in *Loligo* the viscosity of the axoplasm is not constant, but increases after electrical and possibly after mechanical stimulation. The condition of reversible gelation-solvation proposed for the giant axons of *Loligo* suggests that the high viscosity of the axoplasm of the giant fibre of *Myxicola* is a transient condition. It may well be that viscosity increases as the result of mechanical stimulation during dissection, and may be a concomitant feature of quick contraction in the intact animal. This hypothesis probably could be successfully investigated by using the large axons of various sabellids.

No critical studies have been made of neurofibrillae in the living axons of annelids. A few authors have stated that the giant fibres of these animals contain a homogeneous substance, for example, those of *Arenicola* (Gamble and Ash-

worth, 1898) and *Lumbricus* (Friedländer, 1888). Nevertheless, there are numerous descriptions of neurofibrillae in fixed preparations of the giant fibres, giant fibre cells, and smaller neurones of the earthworm (Boule, 1908, 1909, 1913; Kowalski, 1909; Leydig, 1864a; Cajal, 1904). Among polychaetes, Gamble and Ashworth (1900) and Ashworth (1904) found longitudinal striations in the giant axons of *Arenicola* and a neurofibrillar network in the perikaryon of the giant fibre cells. Similar descriptions have been given of the giant axons of *Halla* (Ashworth, 1909) and of *Lumbrineris* and *Notocirrus* (Fedorow, 1928). Spengel (1881) found fine longitudinal striations in the giant fibres of *Spirographis*, and Cunningham (1887) saw fine lines resembling fibres in the giant axons of *Sabella*. Striations are not visible in fresh axoplasm of *Myxicola*, but fine lines, frequently oriented parallel to the axis and surface of the fibre, occur in fixed and stained sections (Nicol, 1948).

FUNCTION OF THE GIANT AXONS

The several studies made of the dorsal giant axons of the earthworm have shown that these structures are concerned with quick end-to-end contractions that cause the animal to shorten and retract into its burrow after tactile stimulation. Although the three dorsal axons can conduct in both directions, like other nerve fibres (Eccles, Granit, and Young, 1933), despite the presence of macrosynapses, in the intact animal the median giant is fired by tactile stimulation in the anterior region, the two lateral giants by tactile stimulation in the posterior region, and all three fibres by stimulation in an intermediate region of the body (Bullock, 1945a; Rushton, 1946; Stough, 1930). Buddenbrock (1928) has postulated still another function for the dorsal giant fibres. He stated that stimulation of the posterior end leads to peristaltic waves at the anterior end of the worm, and vice versa. Since the impulses responsible for these movements must be carried through the length of the nerve cord, he suggested that the giant fibres are involved in this. Ten Cate (1938) has studied this problem and has stated that after transection of the dorsal giant fibres without injuring the rest of the nerve cord, the quick contraction does not pass the lesion, but the creeping reflex does so. On the other hand, if the dorsal giant fibres are left intact but the rest of the nerve cord is cut

across, both the quick contraction and the creeping reflex pass the operated region; that is, stimulation of one end results either in quick contraction or locomotory waves at the other end of the worm, depending on intensity of stimulation. Ten Cate did not describe the histological appearance of his preparations, and it may be argued that the operation of cutting all the small fibres of the nerve cord without interrupting the giant fibres is an impossible one to perform. It is difficult to visualize a nervous mechanism whereby nervous impulses carried by the same nerve fibre, itself having an efferent function, can bring about two quite different responses at different times according to the intensity of the stimulus, as postulated by Buddenbrock and ten Cate. It may be that frequency of impulses in the giant axons is the controlling mechanism. Nothing is known of the function of the ventral giant axons of the Lumbricidae.

Only a beginning has been made in the analysis of the functioning of polychaete giant axons. Bullock (1945b, 1948) has recorded action potentials corresponding to the giant axons from the nerve cord of *Neanthes virens* and has found that each fibre can conduct as a unit in either direction through the nerve cord, independently of the other fibres. Action potentials in all the fibres are evoked by either tactile or electrical stimuli. The median giant is fired by sensory stimulation anteriorly, the small medio-lateral giants by posterior stimulation, and the large lateral giants by stronger stimuli at all levels. The quick shortening reaction of *Nereis* and *Neanthes* is well known (Buddenbrock, 1928; Hamaker, 1898), and Bullock has indicated that the giant axons are concerned in this reaction. Nicol (1947) has cut the giant axon of *Myxicola* without interrupting the rest of the nerve cord, and has found that this operation blocks the passage of quick contractions but not the passage of slower locomotory waves. The evidence shows that the giant nerve fibre of this species conducts the nervous impulses that result in nearly synchronous contraction of all segments. This results in end-to-end shortening and retraction of the feeding crown into the tube. In contrast to the giant fibres of the earthworm, that of *Myxicola* conducts not only in either direction during the natural life of the animal, but can be fired by sensory neurones in any part of the body surface. Nicol, Smyth, and Whitteridge (1947) have made direct recordings of action potentials of the giant axon of *M. infundibulum* and

have found that single fibre action potentials can be picked up from any part of the surface of the animal or from its nerve cord as the result of single electrical or tactile stimuli. An impulse thus originating at any point in this axon is transmitted throughout its extent in the nerve cord as well as in the peripheral nerves, and causes all the longitudinal muscles of the body to contract nearly simultaneously.

Only a limited amount of evidence is available for the functioning of giant axons of other polychaetes. In general, species of sabellids withdraw quickly into their tubes when alarmed. In addition to *Myxicola infundibulum*, this response has been observed in *M. aesthetica*, *Sabella pavonina*, *Spirographis spallanzanii*, *Branchiomma vesiculosum*, *Bispira volutacornis*, *Dasychone bombyx* and *Eudistylia vancouveri*, in the serpulids *Pomatoceros triqueter* and *Protula protula*, and it probably occurs in all species (Claparède, 1870; Hargitt, 1912; St. Joseph, 1894; Soulier, 1891). Since the giant fibres are essentially the same in all sabellids and serpulids, it is reasonable to assume that they form the nervous pathway for this movement. Further investigations may show that in all sabellids and possibly in serpulids as well, the giant axons anastomose with one another and conduct as a unit, and that they are connected with afferent neurones throughout their length. The response is a highly specialized one, well suited to the sedentary mode of existence of these species. All sabellids are tubicolous inactive forms with ciliary methods of feeding. Their tubes are fixed to the substratum or buried in sand or mud; the animals extend their feeding crowns into the water and normally show little movement apart from slow rotation of the crown. They are warned of approaching predators by vibrations, water currents, changes in light intensity, and touch, and these cause the animal to shorten and retract its crown. Other movements are slow peristaltic or anti-peristaltic waves of the body musculature. The pattern of behavior, consequently, is very simple in the Sabellidae. It would appear that one part of the central nervous system, the giant fibre system, has become hypertrophied in response to a sedentary mode of existence, perhaps at the expense of other nervous mechanisms concerned with predatory and free-swimming habits.

Since the giant axons of the earthworm mediate startle reactions, it is generally believed that the giant nerve fibres of polychaetes are concerned

with similar end-to-end contractions of the worm. Quick shortening movements have been described in a number of species other than sabellids and serpulids, e.g., *Neanthes*, *Arenicola*, *Mastobranchus*, *Diopatra* (Bullock, 1948; Friedlander, 1889). In every species in which quick shortening movements occur, the animal is known to possess well-developed giant axons. It is significant, moreover, that giant axons forming through-conducting pathways are present in many burrowing and tubicolous forms (*Sabellaria*, *Mastobranchus*, *Arenicola*, *Nereis*, *Marphysa*, *Eunice*, *Lumbrineris*, *Chlymenella*, *Hyalinoecia*, *Diopatra*). These large axons probably play an important role in the life of the animal in intermediating quick escape mechanisms and, in a recent study, Bullock (1948) has presented some further details of the functional organization of the giant axons of several other polychaetes—non-polarity, areas of effective mechanical stimulation, and “startle” quality of stimuli. For some species it is also possible to make the reverse correlation, namely, that when quick shortening movements are not displayed, giant axons are absent from the nerve cord (*Aphrodita*, *Chaetopterus*, *Amphitrite*, *Cirratulus*; Bullock, 1948). Although the existence of giant axons in the nervous pathway of the giant fibre response of polychaetes now seems to be firmly established, this fact should not preclude examination of the possibility that in some species the giant axons may be concerned with widespread contractions of muscles causing altogether different types of body movements.

GIANT AXON SIZE AND CONDUCTION VELOCITY

The great size of annelid giant nerve fibres suggests that large axon size itself is of considerable survival value and has evolved in response to factors that favor the survival of the individual and the preservation of the species. Pumphrey and Young (1938) have found for the large axons of the stellar nerves of *Loligo* and *Sepia* (Cephalopoda) that conduction is faster in larger axons, and have suggested that conduction velocity varies approximately as the square root of axon diameter. These authors have shown that a significant saving of time is effected by rapid conduction in the large fibres of *Loligo*. Nicol (1948) has extended the same argument to *Myxicola infundibulum*, in comparison with the slow rate of propagation of a nervous impulse in the nerve cord of *Aphrodita*, where giant axons are absent. In a comparison

of this sort it is apparent that the giant axon of *M. infundibulum* has biological value in assisting central nervous system, it conducts an impulse

TABLE 1
Conduction speeds in the nerve cords and giant axons of polychaetes and oligochaetes

SPECIES	MAXIMAL CONDUCTION VELOCITY IN NERVE CORD (m./sec.)	SOURCE	GIANT AXON DIAMETER	SOURCE
<i>Aphrodita</i>	0.5	7	Absent	27a, 37, 124
<i>Cirratulus</i>	0.9	7	Absent	27a, 37, 109
<i>Arenicola</i>	1.2	7		
<i>A. cristata</i>	2	27a		
<i>A. grubei</i> & <i>A. marina</i>			13 μ -43 μ	33, 60, 128
<i>Arabella</i>	1.5	27a	Long distance axons in doubt	27a, 124
<i>Sthenelais fusca</i>	2	7	Present in allied species but size unknown.	124
<i>Polynoë pulchra</i>	2.9	7	Present in allied species but size unknown	124
<i>Pista</i>	4	27a	Large	27a, 99
<i>Clymenella torquata</i>	4	27a	Present	27a, 90
<i>Glycera dibranchiata</i>	4	27a	Large (4 pairs)	27a
<i>G. nigosa</i>	4.3	7		
<i>G. convoluta</i>			16 μ -29 μ	112, 128
<i>Eunice</i>	4.7	7		
<i>E. rousseaui</i> & <i>E. harassi</i>			30 μ -130 μ	43, 85, 112
<i>Lepidametria commensalis</i>	5	27a	Present	27a
<i>Nephtys</i>	3.5, 5	27a	Small (4? fibres)	27a, 37, 101, 130
<i>Nereis</i>	1.6	7		
<i>Neanthes virens</i>	0.9	7		
	Laterals	27, 27a		
	6.2			
	Median			
	5.4			
	Medio-laterals			
	2.5			
<i>Nereis diversicolor</i>			Laterals 40 μ Median 34 μ Medio-laterals 13 μ	112
<i>Haploscoloplos bustorus</i>	5, 7	27a	20 μ (2 fibres)	27a
<i>Lumbrineris</i>	9.4	7	4 fibres, one	27a, 99, 101
	5, 10	27a	very large, 100 μ	109, 138
<i>Eudistylia polymorpha</i> (= <i>Bispira polymorpha</i>)	6.9	7, 28		
<i>E. vancouveri</i>			30 μ -300 μ	Original
<i>Diopatra</i>	10	27a	100 μ	27a
<i>Myxicola infundibulum</i>	20	114	0.1mm.-1mm.	113
<i>Lumbricus</i>	1.5	21, 22		
	Laterals 10-15	26, 42	Laterals 50 μ -60 μ	85, 144
	Median 20-45	125	Median 90 μ -160 μ Myelinated (<i>L. terrestris</i>)	

the animal to escape quickly from danger. Not only its size but its structure and arrangement, as well, are conducive to rapid conduction. Since rapidly through all segments, without the synaptic delay involved in interneuronal transmission from one ganglion to another. Since the motor

branches of the giant axon are continuous with it, there is no synaptic delay on the efferent side of the reflex arc either. Finally, since sensory neurones probably are connected with the giant axon in each segment, the amount of conduction time that would be involved in long sensory pathways is reduced to a minimum. The size and structure of the axon are clearly of importance in permitting this animal to retract faster, and the advantage of such giant axons probably has affected the course of their evolution in the other polychaetes in which they occur. It is of interest to note in this connexion that Bullock (1945a) and Rushton (1946) have commented on the fact that in *Lumbricus* the macrosynapses cause little appreciable delay in nervous conduction; thus even when septal interfaces are present, conduction velocity, other things being equal, approximates that of continuous axons. Efferent branches, continuous with the giant axons in the nerve cord, also occur in species other than *Myxicola*, for example, in *Arenicola* (Gamble and Ashworth, 1898) and in *Lepidasthenia* (Haller, 1889), but their occurrence seems to be the exception rather than the rule.

Representative figures are now available for conduction speeds of the giant axons of several annelids. Jenkins and Carlson (1903) have measured rates of nervous conduction in the nerve cords of several polychaetes by a graphical method, and their results are summarized in Table 1, together with some data from other sources. It is probable that Jenkins and Carlson were measuring giant fibre conduction in some of these species. Bovard's figure for *Lumbricus* was obtained by a graphic method; those of Eccles et al., Bullock, Rushton, and Nicol et al. were obtained by measurements of propagation of action potentials. Giant axons occur in all species that have conduction rates of over 1 m./sec. and are particularly large in *Eunice* (rate 4.7 m./sec.), *Bispira* (rate 6.9 m./sec.), *Lumbrineris* (rate 10 m./sec.), *Myxicola* (rate 20 m./sec.) and in *Lumbricus* (rates from 1.5 to 45 m./sec.). In *Cirratulus* and *Aphrodita*, giant axons are absent or very small. These figures serve to emphasize the relationship of giant fibre diameter to conduction velocity in different annelids.

SHEATH AND FUNCTION OF THE GIANT AXON

In some annelids, the giant axons have thickened myelin sheaths in addition to axis cylinders of

large diameter. Evidence is now available from other groups that conduction velocity is a function of myelin sheath thickness as well as axis cylinder diameter. This relationship has been suggested by a number of authors who have compared nerve fibres belonging to several different species. Among a group of nerve fibres with different sheath thickness but with axis cylinders of the same diameter, the fibres with the thicker sheaths conduct the faster (Prosser, 1946; Pumphrey and Young, 1938; Schmitt and Bear, 1939). Taylor (1940) has pointed out that earthworm giant axons, compared with fibres of the frog, reveal that conduction speed varies both with sheath thickness and fibre diameter, and recently Sanders and Whitteridge (1946) have been able to substantiate this conclusion by utilizing the alteration in axis cylinder diameter and myelin sheath thickness that occurs during nerve regeneration in mammals.

Myelinated giant axons appear to have arisen on several occasions, in polychaetes, oligochaetes, decapod crustacea, and chordates, and their sporadic occurrence in species of several different polychaete families suggests that they have evolved independently in a number of species of this order, namely, in the Spionidae, Maldanidae, and Capitellidae (Friedländer, 1889; Langerhans, 1880; Lewis, 1898). Of the two mechanisms available for increasing conduction velocity, increase in axon diameter and increase in myelin sheath thickness, it appears that in most species of polychaetes evolution has led to enlargement of the axis cylinder; but that in a few species of polychaetes and in lumbricids, evolution has progressed along the alternative path towards increased myelination.

SUMMARY

1. Since their discovery by Claparède in the Oligochaeta in 1861, giant nerve fibres have been found in nearly all families of oligochaetes, and in the following polychaete families: Aphroditidae, Polynoidae, Sigalionidae, Nereidae, Nephtyidae, Glyceridae, Eunicidae, Lumbrineridae, Onuphidae, Lysaretidae, Orbiniidae, Spionidae, Magelonidae, Disomidae, Cirratulidae, Opheliidae, Capitellidae, Arenicolidae, Maldanidae, Fabelligeridae, Sabelariidae, Ampharetidae, Terebellidae, Sabellidae, and Serpulidae.

2. The significance of these large axons was in doubt for half a century. Their nervous nature was proved gradually by histological investigations

which showed that they arise from nerve cells and that they branch, and from studies which revealed changes in behavior after cutting these fibres.

3. In the earthworm three large dorsal fibres are present. These axons extend throughout the nerve cord but are divided into longitudinal units by septa in each segment. They are syncytial structures, since they receive the processes of several nerve cells in each segment, and they have well developed myelin sheaths. One to three giant axons occur in other families of oligochaetes.

4. Several quite distinct patterns of giant axons are present in polychaetes. They may be intrasegmental and enter the peripheral nerves (Aphroditidae, Polynoidae, Sigalionidae, Ichthyotomidae); or they may be intersegmental and extend through many neuromeres (Polynoidae, Sigalionidae, Eunicidae, Lysaretidae, Onuphidae, Arenicolidae, Nereidae, Maldanidae, Capitellidae, Sabelariidae, Sabellidae, Serpulidae, and others). Both unicellular and multicellular giant axons occur in polychaetes. Unicellular giant axons are present in species of Sigalionidae and Lysaretidae; syncytial giant axons are probably more frequent and occur in species of Arenicolidae, Maldanidae, Capitellidae, and Sabellidae. Where the axons possess definite structural polarity, with their nerve cells restricted to particular regions of the central nervous system, they form groups of fibres running from the anterior region of the nerve cord towards the tail, or in a reverse direction, or both (*Euthalenessa* and *Sigalion* in the Sigalionidae; *Halla* and *Aglaurides* in the Lysaretidae). Intersegmental septa have been described in only one species of polychaete (*Nereis*), and it is probable that the majority of polychaete giant axons are continuous structures.

5. Annelid giant axons vary in size from about 10μ in *Nephtys* to 1.7 mm. in *Myxicola infundibulum*. In the earthworm, the median axon may reach 160μ in diameter, and the lateral axons are about half as large. They are particularly large in burrowing or tubicolous polychaetes (*Hyalinocia*, *Eunice*, *Arenicola*, *Lumbrineris*, sabellids in general). In any one uniform group, like the Sabellidae, the fibres vary in dimensions with the size of the species, the size of the individual, and the state of extension. They also show progressive alterations in diameter along their length and, occasionally, regularly occurring variations in diameter in the form of constrictions.

6. Giant axons are surrounded by sheaths of

supporting cells and fibres. The sheaths are myelinated in some lumbricids, spionids, capitellids, and maldanids. Myelination appears to be absent or weakly developed in sabellids, lysaretids, arenicolids, and nereids.

7. Very little is known of the development of annelid giant axons. It is suggested that multicellular giant axons which begin in one or several nerve cells in the supraoesophageal ganglia or anterior nerve cord develop as processes of these cells, and that intrasegmental giant neurones establish connections with these advancing axons secondarily. Where the giant axons are divided into segmental units, it is more probable that they develop from the apposition of hypertrophied intrasegmental neurones at the boundaries of each metamere.

8. More evidence is needed before firm conclusions can be formulated about the homologies and evolution of giant axons in the Annelida. The diversity of structure and arrangement found in the giant axons of chaetopods, however, indicates that they have arisen independently in the Oligochaeta and in different families of the Polychaeta, as different groups have become specialized for tubicolous and burrowing habits.

9. From experiments in which the giant axons have been cut and from electrical recordings of action potentials, it has been established that the giant axons of *Lumbricus* conduct nervous impulses resulting in quick contractions of the entire body. The three axons of this animal conduct in either direction as the result of tactile and electrical stimulation but, owing to differences in sensory connexions, the median giant conducts predominantly posteriorly and the lateral giants conduct predominantly anteriorly.

10. The giant axons of many polychaetes probably have a function similar to those of the earthworm, and conduct impulses leading to quick contraction and retraction from danger. This has been established for *Myxicola infundibulum* by cutting the giant axon and by recordings of action potentials. In *Myxicola* the giant axon conducts anteriorly and posteriorly as the result of natural stimulation and is connected with sensory neurones throughout its length. In *Neanthes* one of the giant axons is connected with afferent neurones throughout its extent, while the others have more spatially restricted sensory connexions. Species of *Arenicola*, *Mastobranchus*, *Diopatra*

Clymenella, of the Nereidae, and the Sabellidae are capable of quick retreat by widespread contraction of longitudinal muscles, and in these forms at least the giant axons very likely are concerned in intermediating this startle reaction.

11. Giant axons have considerable biological value to a species by saving conduction time, and thereby permitting the animal to retreat faster. Factors which reduce the time interval between stimulation and onset of movement are: large axon diameter, with concomitant increase in conduction velocity; continuous conducting path throughout the nerve cord; short afferent pathways between the body wall and the giant axon; in some

species, continuous efferent pathways between the giant axon and the longitudinal musculature of the body wall in each segment.

12. Measured conduction velocities of annelid giant axons vary from about 2 m. per sec. in *Arenicola* and 6 m. per sec. in *Nereis* to 45 m. per sec. in *Lumbricus*. In general, conduction velocity is greater in myelinated than in unmyelinated fibres of the same axis cylinder diameter. Increase in conduction velocity seems to have been effected independently in the different groups of oligochaetes and polychaetes, either by increase in fibre diameter or by increase in myelin sheath thickness.

LIST OF LITERATURE

- ALLEN, E. J. 1904. The anatomy of *Poecilochaetus*, Claparède. *Quart. J. micr. Sci.*, 48: 79-151.
- ASHWORTH, J. H. 1901. The anatomy of *Scalibregma inflatum*, Rathke. *Quart. J. micr. Sci.*, 45: 237-309.
- . 1903. The anatomy of *Arenicola assimilis*, Ehlers, and of a new variety of the species, with some observations on the post-larval stages. *Quart. J. micr. Sci.*, 46: 737-785.
- . 1904. *Arenicola* (The Lugworm). Liverpool Mar. Biol. Committee Memoir XI, pp. viii + 118, London.
- . 1908. The giant nerve cells and fibres of *Halla parthenopeia*. *Proc. Roy. Soc. Lond.*, B, 80: 463-464 (Abstract).
- . 1909. The giant nerve cells and fibres of *Halla parthenopeia*. *Phil. Trans. Roy. Soc. Lond.*, B, 200: 427-521.
- . 1910a. The annelids of the family Arenicolidae of North and South America, including an account of *Arenicola glacialis* Murdoch. *Proc. U. S. Natl. Mus.*, 39: 1-32.
- . 1910b. An account of *Arenicola loveni* Kinberg. *Ark. Zool.*, Stockholm, 7: 1-19.
- . 1911. The Arenicolidae of South Africa, including an account of *Arenicola loveni* Kinberg. *Ann. S. Afr. Mus.*, 11: 1-27.
- . 1912. Observations on the structure and affinities of *Branchiomaldane vincenti* Langerhans. *Proc. Roy. Soc. Edin.*, 32: 62-67.
- ATTEMS, C. G. 1903. Beiträge zur Anatomie und Histologie von *Scololepis fuliginosa* Clap. *Arch. Zool. Inst. Wien.*, 14: 173-210.
- BAKER, J. R. 1944. The structure and chemical composition of the Golgi element. *Quart. J. micr. Sci.*, 85: 1-71.
- BEAR, R. S., AND F. O. SCHMITT. 1937. Optical properties of the axon sheaths of crustacean nerves. *J. cell. comp. Physiol.*, 9: 275-287.
- BEDDARD, F. E. 1883. On the anatomy and histology of *Pleurochaeta moseleyi*. *Trans. Roy. Soc. Edin.*, 30: 481-509.
- . 1895. *A monograph of the order Oligochaeta*. Clarendon Press, Oxford.
- BENHAM, W. B. 1887. Studies on earthworms. No. III. *Criodrilus lacuum*, Hofmeister. *Quart. J. micr. Sci.*, 27: 561-572.
- BODIAN, D., AND R. C. MELLORS. 1945. The regenerative cycle of motoneurons, with special reference to phosphatase activity. *J. exp. Med.*, 81: 469-488.
- BOULE, L. 1908. L'imprégnation des éléments nerveux du lombric par le nitrate d'argent. *Le Névrase*, 9: 313-327.
- . 1909. Recherches sur le système nerveux central normal du lombric. *Le Névrase*, 10: 13-59.
- . 1913. Nouvelles recherches sur le système nerveux central du lombric. *Le Névrase*, 15: 425-467.
- BOVARD, J. F. 1915. Giant fiber action and normal transmission by the nerve cord of earthworms. *Science*, 42: 620.
- . 1918a. The transmission of nervous impulses in relation to locomotion in the earthworm. *Univ. Calif. Publ. Zool.*, 18: 103-134.
- . 1918b. The functions of the giant fibers in earthworms. *Univ. Calif. Publ. Zool.*, 18: 135-144.
- BRUNOTTE, C. 1888. Recherches anatomiques sur une espèce du genre *Branchiomma*. *Travaux Sta. Zool. Cette*, pp. 77. Quoted by Ashworth, 1909.
- BUDDENBROCK, W. VON. 1928. *Grundriss der vergleichenden Physiologie*. Gebrüder Borntraeger, Berlin.
- BULLOCK, T. H. 1945a. Functional organization of the giant fiber system of *Lumbricus*. *J. Neurophysiol.*, 8: 55-71.
- . 1945b. Organization of the giant nerve fiber

- system in *Neanthes virens*. *Biol. Bull.*, 89: 185-186 (Abstract).
- BULLOCK, T. H. 1948. Physiological mapping of giant nerve fiber systems in polychaete annelids. *Physiol. comp. Oecol.*, 1: 1-14.
- CARLSON, A. J. 1905 Further evidence of the fluidity of the conducting substance in nerve. *Amer. J. Physiol.*, 13: 351-357.
- CERFONTAINE, P. 1892. Contribution à l'étude du système nerveux central du lombric terrestre. *Bull. Acad. Roy. Belg.*, 23: 742-752.
- CLAPARÈDE, E. 1861. Études anatomiques sur les annélides, turbellariés, opalines et grégaires observés dans les Hébrides. *Mém. Soc. Phys. Genève*, 16: 71-164.
- . 1862. Recherches anatomiques sur les oligochètes. *Mém. Soc. Phys. Genève*, 16: 217-291.
- . 1863. *Beobachtungen über Anatomie und Entwicklungsgeschichte wirbelloser Thiere an der Küste von Normandie angestellt*. viii + 120 pp. Wilhelm Engelmann, Leipzig.
- . 1868. *Les annélides chétopodes du Golfe de Naples*. 500 pp. H. Georg, Genève et Basle. (Reprinted from *Mém. Soc. Phys. Genève*, 19: 313-584.)
- . 1869. Histologische Untersuchungen über den Regenwurm (*Lumbricus terrestris* Linné). *Z. wiss. Zool.*, 19: 563-624.
- . 1870. Les annélides chétopodes du Golfe de Naples. *Mém. Soc. Phys. Genève*, 20: 365-542 (Supplément).
- . 1873. Recherches sur la structure des annélides sédentaires. *Mém. Soc. Phys. Genève*, 22: 1-200.
- CUNNINGHAM, J. T. 1887. On some points in the anatomy of Polychaeta. *Quart. J. micr. Sci.*, 28: 239-278.
- , and G. A. RAMAGE. 1888. The Polychaeta Sedentaria of the Firth of Forth. *Trans. Roy. Soc. Edin.*, 33: 635-684.
- DARBOUX, J. G. 1899. Recherches sur les aphroditens. *Trav. Inst. Zool. Univ. Montpellier & Sta. Mar. Cette*. Mém. 6 (2^e série).
- DEHORNE, A. 1935. Sur le neuroplasma des fibres géantes des polychètes. *C. R. Soc. Biol.*, 119: 1253-1256.
- DEMPSEY, E. W., and G. B. WISLOCKI. 1946. Histochemical contributions to physiology. *Physiol. Rev.*, 26: 1-27.
- ECCLES, J. C., R. GRANIT, and J. Z. YOUNG. 1933. Impulses in the giant nerve fibres of earthworms. *Proc. Physiol. Soc.*, P23-P25 (in *J. Physiol.*, 77).
- EHLERS, E. 1868. *Die Borstenwürmer (Annelida chaetopoda) nach systematischen und anatomischen Untersuchungen dargestellt*. Bd. 1, xx + 748 pp. Wilhelm Engelmann, Leipzig.
- Ehrenberg, C. G. 1836. Beobachtung einer bisher unbekannten auffallendens Structur des Seelenorgans bei Menschen und Thieren. *Akad. wiss. Abh. phys. Kl. Berlin*, 1834. Berlin.
- EISIG, H. 1887. *Monographie der Capitelliden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte, nebst Untersuchungen zur vergleichenden Anatomie und Physiologie*. Fauna und Flora Neapel, Monogr. 16, R. Friedländer & Sohn, Berlin.
- . 1906. *Ichthyotomus sanguinarius, eine auf Aalen schmarotzende Annelide*. Fauna und Flora Neapel, Monogr. 28, R. Friedländer & Sohn, Berlin.
- EMERY, C. 1886. La régénération des segments postérieurs du corps chez quelques annélides polychètes. *Arch. Ital. Biol.*, 7: 395-403.
- EVENKAMP, H. 1931. Morphologie, Histologie und Biologie der Sabellidenspecies *Laonome kroyeri* Malmgr. und *Euchone papillosa* M. Sars. *Zool. Jahrb. Abt. Anat. Ont.*, 53: 405-534.
- FAUVEL, P. 1897. Recherches sur les ampharétiens, annélides polychètes sédentaires, morphologie, anatomie, histologie, physiologie. *Bull. Sc. Fr. Belg.*, 30: 277-488.
- . 1899. Observations sur l'*Arenicola ecaudata* Johnston. *Bull. Soc. Linn. Normandie*, 2: 1-32.
- . 1923. *Faune de France*. 5. Polychètes errantes. P. Lechevalier, Paris.
- . 1927. *Faune de France*. 16. Polychètes sédentaires. P. Lechevalier, Paris.
- FEDOROW, B. 1928. Über den Bau der Riesenganglienzellen der Lumbriconereinen. *Z. mikr. anat. Forsch.*, 12: 347-370.
- FLAIG, J. V. 1947. Viscosity changes in axoplasm under stimulation. *J. Neurophysiol.*, 10: 211-222.
- FRAIPONT, J. 1887. *Le genre Polygordius*. Fauna und Flora Neapel, Monogr. 14, R. Friedländer & Sohn, Berlin.
- FRIEDLÄNDER, B. 1888. Beiträge zur Kenntnis des Centralnervensystems von *Lumbricus*. *Z. wiss. Zool.*, 47: 47-84.
- . 1889. Über die markhaltigen Nervenfasern und Neurochorde der Crustaceen und Anneliden. *Mitt. Zool. Sta. Neapel*, 9: 205-265.
- . 1894. Altes und Neues zur Histologie des Bauchstranges des Regenwurms. *Z. wiss. Zool.*, 58: 661-693.
- GAMBLE, F. W., and J. H. ASHWORTH. 1898. The habits and structure of *Arenicola marina*. *Quart. J. micr. Sci.*, 41: 1-42.
- , and —. 1900. The anatomy and classification of the Arenicolidae, with some observations on their post-larval stages. *Quart. J. micr. Sci.*, 43: 419-569.
- GATENBY, J. B., and T. S. PAINTER. 1937. *The microtome's vade-mecum* (Bolles Lee), Tenth edition. J. & A. Churchill, London.
- GRAVIER, C. 1898. Étude du prostomium des gly-

- cériens suivie de considérations générales sur le prostomium des annélides polychètes. *Bull. Sc. Fr. Belg.*, 31: 159-184.
- HALL, A. R. 1921. Regeneration in the annelid nerve cord. *J. comp. Neurol.*, 33: 163-191.
- HALLER, B. 1889. Beiträge zur Kenntniss der Textur des Centralnervensystems höherer Würmer. *Arb. Zool. Inst. Wien*, 8: 175-312.
- HAMAKER, J. I. 1898. The nervous system of *Nereis virens* Sars. A study in comparative neurology. *Bull. Mus. Comp. Zool. Harv.*, 32: 87-124.
- HARGITT, C. W. 1912. Observations on the behaviour of tubicolous annelids. III. *Biol. Bull.*, 22: 67-94.
- HARRISON, R. G. 1913. The life of tissues outside the organism from the embryological standpoint. *Trans. Cong. Amer. Physicians Surgeons*, 9: 63-76.
- HARTMAN, O. 1936. Nomenclatorial changes involving California polychaete worms. *J. Wash. Acad. Sci.*, 26: 31-32.
- . 1938. Annotated list of the types of polychaetous annelids in the Museum of Comparative Zoölogy. *Bull. Mus. Comp. Zool. Harv.*, 85: 1-31.
- . 1942a. A review of the types of polychaetous annelids at the Peabody Museum of Natural History, Yale University. *Bull. Bingham Oceano. Coll.*, 8 (Art. 1), pp. 98.
- . 1942b. The identity of some marine annelid worms in the United States National Museum. *Proc. U. S. Natl. Mus.*, 92: 101-140.
- . 1944. New England Annelida. Pt. 2. *Bull. Amer. Mus. Nat. Hist.*, 82: 327-344.
- . 1948. The polychaetous annelids of Alaska. *Pac. Sci.*, 2: 3-58.
- HASWELL, W. A. 1886. Observations on some Australian Polychaeta. Pt. I. *Proc. Linn. Soc. N.S.W.*, 10: 733-756.
- HATSCHKE, B. 1878. Studien über die Entwicklungsgeschichte der Anneliden. *Arb. Zool. Inst. Wien*, 1: 277-404.
- HEIDENHAIN, M. 1911. *Plasma und Zelle*. G. Fischer, Jena. Quoted by Bodian and Mellors, 1945.
- HEMPELMANN, F. 1906. Zur Morphologie von *Polygordius lacteus* Schn. und *Polygordius triestinus* Woltereck, nov. spec. *Z. wiss. Zool.*, 84: 527-618.
- HOLMES, W. 1942. The giant myelinated nerve fibres of the prawn. *Phil. Trans. Roy. Soc. Lond.*, B, 231: 293-311.
- HÖNIG, J. 1910. Die Neurochorde des *Criodrilus lacuum* Hoffmstr. *Arb. Zool. Inst. Wien*, 18: 257-282.
- JACOBI, R. 1883. *Anatomisch-histologische Untersuchung der Polydoren der Kieler Bucht*. Inaug.-Dissert. 35 pp. Kiel.
- JENKINS, O. P., and A. J. CARLSON. 1903. The rate of the nervous impulse in the ventral nerve-cord of certain worms. *J. comp. Neurol.*, 13: 259-289.
- JOHNSON, G. E. 1924. Giant nerve fibers in crustaceans, with special reference to *Cambarus* and *Palaemonetes*. *J. comp. Neurol.*, 36: 323-373.
- JOURDAN, E. 1887. Études histologiques sur deux espèces du genre *Eunice*. *Ann. Sci. nat. zool.*, 2: 238-304.
- KEFERSTEIN, W. 1863. Untersuchungen über niedere Seethiere. *Z. wiss. Zool.*, 12: 1-147.
- KEYL, F. 1913. Beiträge zur Kenntnis von *Branchiura sowerbyi* Beddard. *Z. wiss. Zool.*, 107: 199-308.
- KOWALSKI, J. 1909. Contribution à l'étude des neurofibrilles chez le lombric. *La Cellule*, 25: 289-347.
- KRAWANY, J. 1905. Untersuchungen über das Zentralnervensystem der Regenwürmer. *Arb. Zool. Inst. Wien*, 15: 281-316.
- KÜKENTHAL, W. 1887. Über das Nervensystem der Opheliaceen. *Jen. Z. Naturw.*, 20: 511-580.
- LANGERHANS, P. 1880. Die Wurmfauuna von Madeira. III. *Z. wiss. Zool.*, 34: 87-143.
- LEWIS, M. 1898. Studies on the central and peripheral nervous system of two polychaete annelids. *Proc. Amer. Acad. Arts Sci.*, 33: 225-268.
- LEYDIG, F. 1864a. *Vom Bau des thierischen Körpers. Handbuch der vergleichenden Anatomie*, Bd. 1. vi + 278 pp. Tübingen.
- . 1864b. *Tafeln zur vergleichenden Anatomie*. 1. Zum Nervensystem und den Sinnesorganen der Würmer und Gliederfüssler. 24pp. Tübingen.
- . 1865. Ueber den *Phreoryctes menkeanus* Hofm. nebst Bemerkungen über den Bau anderer Anneliden. *Arch. mikr. Anat.*, 1: 249-294.
- . 1886. Die riesigen Nervenröhren im Bauchmark der Ringelwürmer. *Zool. Anz.*, 9: 591-597.
- LISON, L. 1936. *Histochimie animale. Méthodes et problèmes*. Gauthier-Villars, Paris.
- LIVANOFF, N. 1924. Recherches sur l'anatomie du système nerveux des polychètes. *Arch. Russ. Anat. Histol., Embryol.* (= *Russk. Arkh. Anat.*), 3: 3-59.
- MCINTOSH, W. C. 1877. On the arrangement and relations of the great nerve-cords in the marine annelids. *Proc. Roy. Soc. Edin.*, 9: 372-381 (Abstract).
- . 1878. Beiträge zur Anatomie von *Magelona*. *Z. wiss. Zool.*, 31: 401-472.
- . 1885. Report on the Annelida Polychaeta collected by H.M.S. 'Challenger' during the years 1873-1876. *Challenger Rep., Zool*, 12: xi + 554. H. M. Stationery Office, London.
- . 1918. Notes from the Gatty Marine Laboratory, St. Andrews.-No. XLI. 1. On some points in the structure of the Sabellidae, chiefly of *Bispira volutacornis*, Montagu. 2. On some points in the

- structure of the Serpulidae, chiefly of *Pomatoceros triquetus*, L. *Ann. Mag. nat. Hist.*, 2: 1-59.
- MCINTOSH, W. C. 1923. *A monograph of the British annelids*. 4 vols. *Polychaeta*, vols. II-IV. Ray Soc., London.
- . 1925. Notes from the Gatty Marine Laboratory, St. Andrews.-No. XLVIII. A second contribution to the structure of the Tomopteridae. *Ann. Mag. nat. Hist.*, 16: 289-322.
- MALACQUIN, A. 1893. Recherches sur les syllidiens; morphologie, anatomie, reproduction, développement. *Mém. Soc. Sci. Arts Lille*, 14: 1-477.
- MEYER, E. 1882. Zur Anatomie und Histologie von *Polyophthalmus pictus* Clap. *Arch. mikr. Anat.*, 21: 769-823.
- . 1887. Studien über den Körperbau der Anneliden. *Mitt. Zool. Sta. Neapel*, 7: 592-741.
- . 1888. Studien über den Körperbau der Anneliden. *Mitt. Zool. Sta. Neapel*, 8: 462-662.
- MICHAELSEN, W. 1886. *Untersuchungen über Enchytraeus möbii* Mich. und andere Enchytraeiden. Inaug.-Dissert., Zool. Inst. Kiel. 50 pp. Kiel.
- MICHEL, A. 1898. Recherches sur la régénération chez les annélides. *Bull. Sc. Fr. Belg.*, 31: 245-420.
- . 1899. Sur les canaux neuraux et les fibres nerveuses des annélides. *Miscellanées biologiques dédiées au Professeur A. Giard. Trav. Sta. Zool. Wimereux*, 7: 478-488.
- NANSEN, F. 1887a. The structure and combination of the histological elements of the central nervous system. *Bergens Mus. Aarsb.*, 1886: 27-215.
- . 1887b. Anatomie und Histologie des Nervensystems der Myzostomen. *Jen. Z. Naturw.*, 21: 267-321.
- NICOL, J. A. C. 1947. *Giant nerve fibres in the central nervous system of polychaete worms*. D. Phil. Thesis, Bodleian Library, Oxon.
- . 1948. The giant nerve fibres in the central nervous system of *Myxicola* (Polychaeta, Sabelidae). *Quart. J. micr. Sci.*, 89: 1-45.
- , C. N. SMYTH, and D. WHITTERIDGE. 1947. Conduction velocity in relation to axon diameter in *Myxicola infundibulum*. *Abstracts of Communications, XVII Intern. Physiol. Cong., Oxford, 1947*: 243-244.
- , and J. Z. YOUNG. 1946. Giant nerve fibre of *Myxicola infundibulum* (Grube). *Nature*, 158: 167.
- OWENS, H. B., and R. R. BENSLEY. 1929. On osmic acid as a microchemical reagent with special reference to the reticular apparatus of Golgi. *Amer. J. Anat.*, 44: 79-109.
- PERRIER, E. 1874. Études sur l'organisation des lombriciens terrestres. *Arch. Zool. exp. gén.*, 3: 331-530.
- . 1897. *Traité de Zoologie*. Fasc. 4, pp. 1595-1596. G. Masson, Paris.
- PROSSER, C. L. 1946. The physiology of nervous systems of invertebrate animals. *Physiol. Rev.*, 26: 337-382.
- PRUVOT, G. 1885. Recherches anatomiques et morphologiques sur le système nerveux des annélides polychètes. *Arch. Zool. exp. gén.*, 3: 211-336.
- PUMPHREY, R. J., and J. Z. YOUNG. 1938. The rates of conduction of nerve fibres of various diameters in cephalopods. *J. exp. Biol.*, 15: 453-466.
- RAMÓN Y CAJAL, S. 1904. Neuroglia y neurofibrillas des *Lumbricus*. *Trab. Lab. Invest. Biol. Univ. Madr.*, 3: 277-285.
- RETZIUS, G. 1891. Zur Kenntniss des centralen Nervensystems der Würmer. *Biol. Untersuch., Stockholm*, n.f., 2: 1-28.
- ROHDE, E. 1887. Histologische Untersuchungen über das Nervensystem der Polychaeten. *Zool. Beitr.*, 2: 1-81.
- RUSHTON, W. A. H. 1945a. Action potentials from the isolated nerve cord of the earthworm. *Proc. Roy. Soc. Lond.*, B, 132: 423-437.
- . 1945b. Motor responses from giant fibres in the earthworm. *Nature*, 156: 109-110.
- . 1946. Reflex conduction in the giant fibres of the earthworm. *Proc. Roy. Soc. Lond.*, B, 133: 109-120.
- SAINT JOSEPH, BARON DE. 1894. Les annélides polychètes des côtes de Dinard. 3^{me} partie. *Ann. Sc. nat. zool.*, 17: 1-395.
- SANDERS, F. K., and D. WHITTERIDGE. 1946. Conduction velocity and myelin thickness in regenerating nerve fibres. *J. Physiol.*, 105: 152-174.
- SCHACK, F. 1886. *Anatomisch-histologische Untersuchung von Nephthys caeca Fabricius*. Inaug. Dissert., Zool. Inst. Kiel. 40 pp. Kiel.
- SCHMITT, F. O., and R. S. BEAR. 1939. The ultrastructure of the nerve axon sheath. *Biol. Rev.*, 14: 27-50.
- SCHRÖDER, G. 1886. *Anatomisch-histologische Untersuchung von Nereis diversicolor*, O. Fr. Müll. Inaug.-Dissert., Zool. Inst. Kiel. 41 pp. Rathe-now.
- SCHULTZE, H. 1879. Die fibrilläre Structur der Nerven-elemente bei Wirbellosen. *Arch. mikr. Anat.*, 16: 57-111.
- SMALLWOOD, W. M. 1930. The nervous structure of the annelid ganglion. *J. Comp. Neurol.*, 51: 377-392.
- , and M. T. HOLMES. 1927. The neurofibrillar structure of the giant fibers in *Lumbricus terrestris* and *Eisenia foetida*. *J. comp. Neurol.*, 43: 327-345.
- SOULIER, A. 1891. Études sur quelques points de l'anatomie des annélides tubicoles de la région de Cette etc. *Trav. Sta. Zool. Cette*, Mém. 2. 310 pp.
- SPEIDEL, C. C. 1935. Studies of living nerves. III. Phenomena of nerve irritation and recovery, degeneration and repair. *J. comp. Neurol.*, 61: 1-80.

- SPENGLER, J. W. 1881. *Oligognathus bonelliae*, eine schmarotzende Eunicee. *Mitt. Zool. Sta. Neapel*, 3: 15-52.
- STEEN, J. 1833. Anatomisch-histologische Untersuchung von *Terebellides stroemii*, M. Sars. *Jen. Z. Naturw.*, 16: 201-246.
- STEPHENSON, J. 1912. On *Branchiura sowerbyi* Beddard, and on a new species of *Limnodrilus* with distinctive characters. *Trans. Roy. Soc. Edin.*, 48: 285-303.
- . 1930. *The Oligochaeta*. Clarendon Press, Oxford.
- STOUGH, H. B. 1926. Giant nerve fibers of the earthworm. *J. comp. Neurol.*, 40: 409-463.
- . 1930. Polarization of the giant nerve fibers of the earthworm. *J. comp. Neurol.*, 50: 217-229.
- TAYLOR, G. W. 1940. The optical properties of the earthworm giant fiber sheath as related to fiber size. *J. cell. comp. Physiol.*, 15: 363-371.
- TEN CATE, J. 1938. Sur la fonction des neurochordes de la chaîne ventrale du ver de terre (*Lumbricus terrestris*). *Arch. Néerl. Physiol.*, 23: 136-140.
- THOMAS, J. G. 1940. *Pomatoceros, Sabella and Amphitrite*. Liverpool Mar. Biol. Committee, Memoir XXXIII. viii + 88 pp. Liverpool.
- TREADWELL, A. L. 1891. Preliminary note on the anatomy and histology of *Serpula dianthus* (Verrill). *Zool. Anz.*, 14: 276-280.
- VEJDOVSKÝ, F. 1878. Beiträge zur Kenntniss der Tomopteriden. *Z. wiss. Zool.*, 31: 81-100.
- . 1884. *System und Morphologie der Oligochaeten*. 167 pp. Kais. Akad. Wiss. Wien. Řivnáč, Prague.
- . 1892. *Entwicklungsgeschichtliche Untersuchungen*. Bd. I, iv + 402 pp. Bd. II, Tafeln. J. Otto, Prague.
- VIGNAL, W. 1883. Recherches histologiques sur les centres nerveux de quelques invertébrés. *Arch. Zool. exp. gén.*, 1: 267-412.
- WAWRZIK, E. 1892. Über das Stützgewebe des Nervensystems der Chaetopoden. *Zool. Beitr.*, 3: 107-127.
- WIERSMA, C. A. G. 1947. Giant nerve fiber system of the crayfish. A contribution to comparative physiology of synapse. *J. Neurophysiol.*, 10: 23-38.
- WILSON, E. B. 1889. The embryology of the earthworm. *J. Morph.*, 3: 387-462.
- YOLTON, L. W. 1923. The effects of cutting the giant fibers in the earthworm, *Eisenia foetida* (Sav.). *Proc. Natl. Acad. Sci. Wash.*, 9: 383-385.
- YOUNG, J. Z. 1934. Structure of nerve fibres in *Sepia*. *Proc. Physiol. Soc.*, P.1-P.2 (in *J. Physiol.*, 83).
- . 1936a. Structure of nerve fibres and synapses in some invertebrates. *Cold Spring Harbor Symp. Quant. Biol.*, 4: 1-6.
- . 1936b. The giant nerve fibres and epistellar body of cephalopods. *Quart. J. micr. Sci.*, 78: 367-386.
- . 1936c. The structure of nerve fibres in cephalopods and crustacea. *Proc. Roy. Soc. Lond., B.*, 121: 319-337.
- . 1939. Fused neurons and synaptic contacts in the giant nerve fibres of cephalopods. *Phil. Trans. Roy. Soc. Lond., B*, 229: 465-503.
- . 1944. Giant nerve-fibres. *Endeavour*, 3: 108-113.



THE PRINCIPLE OF STABILITY AS A CAUSE OF EVOLUTION A REVIEW OF SOME THEORIES

By S. J. HOLMES

Department of Zoology, University of California

AMID the luxuriant crop of rival theories which sprang up after the publication of Darwin's views on the origin of species, a large proportion falls under the general heading of orthogenesis, a term denoting evolution along definitely directed lines, but agreeing in little else except that the direction of these lines is *not* caused by natural selection. Virtually all of the proponents of orthogenesis stress the importance of ascertaining the causes of variation, and contend that Darwin's theory is inadequate because of its failure to give a reasonable solution of this problem. In general, the orthogenesisists are largely hostile to Darwin's conception that variations are largely "fortuitous," and they would substitute some more sober and law-abiding kind of variability for the random "chance" happenings with which Darwin believed his theory could get along.

As to what these uniformly acting causes are, we find the greatest variety of assumptions. They range from divine guidance and teleological control to purely mechanical explanations. Lamarckian heredity, with the various hypotheses as to how it can be accounted for, figures prominently in theories of directed variability, and in several cases it is associated with an appeal to a teleological factor or some other principle not clearly defined. It is not my intention to review the varied theories of orthogenesis. Out of the great diversity of speculative endeavors, many of which have little interest in the light of present-day knowledge, I confine myself to a single fairly well defined class based on the so-called principle of stability which most of its upholders have derived from the law of entropy, or the second law of thermodynamics.

The principle of stability as a factor in evolution was elaborated by G. T. Fechner in a brochure entitled *Einige Ideen zur Schöpfungs- und Entwicklungsgeschichte der Organismen*, published in 1873. Fechner endeavored to show that throughout

nature there is a marked tendency for material to form bodies of varying degrees of stability, a tendency which he regarded as closely related in its action to the conservation of energy. Theoretically, he stated, there may be absolute stability or absolute instability, but both of these conditions are never completely realized. A body at rest represents a limiting condition which, in the absence of disturbing outer forces, may persist indefinitely. There may also be aggregates whose parts undergo continual movements that bring about the recurrence of a given state in regular cycles, as may be illustrated by the solar system. It is assumed that if any group of moving bodies were limited to a space into which and from which no energy or material could pass, the movements of these bodies would in time settle down into a regular series of recurring changes. In a state of nature, bodies, according to Fechner, *tend* to form stable groups of this kind, but they encounter so many disturbing influences that only under certain conditions, as in the movements of the heavenly bodies, does this tendency become manifest. On the earth it comes to expression more or less conspicuously in the realm of organic life. Life processes typically run through a series of changes that repeat themselves generation after generation, and within the individual organism there may be various rhythms, like the beating of the heart, which are subordinate to the larger rhythms of the life cycle. A living being represents a kind of dynamic equilibrium which responds to changes from without by modifications that preserve the life of the whole. Fechner has contended that the more complex types are the more stable ones and that hence life tends to manifest itself in more and more highly organized forms.

Fechner proposed his theory as supplementary to the theory of Darwin. He acknowledged the important function of natural selection in the progressive development of life, but he held that Dar-

win's theory, by itself alone, is incapable of giving a satisfactory explanation of the process. He regarded his principle of stability as of more fundamental import than the theory of natural selection. Unfortunately, Fechner's exposition of it was associated with a number of speculations which doubtless contributed to its belated recognition. The idea that inorganic molecules came originally from living organic molecules, instead of the reverse; the theory that species and even most varieties represent the culmination of independent lines of descent, instead of the terminal twigs of a branching genealogical tree; and the notion that the whole evolution of life occurs as a kind of unit, in which the mutual relationships of living beings result from preformed relations occurring in the primitive organic molecules from which all life, as well as the inorganic world, took its origin; to say nothing of other speculations still more at variance with the prevailing conceptions of biologists in general,—these certainly lent no support to Fechner's evolutionary standpoint.

The formulation of the stability principle was not entirely original with Fechner. Its essential components had been clearly and much more logically set forth by Herbert Spencer in his *First Principles* in 1862. In many, if not in most, respects the ideologies of Fechner and Spencer were widely divergent, but they have a few basic similarities in common. Spencer endeavored to give a deductive derivation of his law of evolution. In his conception, the fundamental factor of "the persistence of force" leads to certain derivative general principles, viz., the multiplication of effects, the instability of the homogeneous, segregation, differentiation, and equilibration, which, taken together, give rise to the process of evolution as a resultant effect. Little is said in *First Principles* about natural selection, except as a kind of secondary agency to which, at times, Spencer was glad to be able to appeal. His basal concept of evolution took its form independently of Darwin, and in large measure before Darwin's *Origin of Species* appeared. As in Fechner's later theory, Spencer held that an essential role in the process of evolution is played by the "instability of the homogeneous," and hence by implication, by the stability of the heterogeneous. This principle was supposed to apply in all phases of the evolutionary process, from the genesis of planetary systems out of nebulae to the evolution of human societies. Spencer supported his law with a large amount of

inductive evidence drawn from a variety of fields. His attempt to derive it from first principles constituted a striking difference between his treatment of evolution and that of Charles Darwin. In Darwin's writings there is no intimation that evolution simply had to come about as a result of antecedent principles. Darwin was convinced that evolution must have occurred, simply because the facts of observation pointed in that direction. And the direction of evolution was not regarded as inevitably toward greater complexity—it might be forward, backward, or sidewise, as conditions determine.

Both Spencer and Fechner invoked the principle of stability in their idea of the instability of the homogeneous and the consequent tendency of organisms to become more complex as a result of general laws which obtain in the physical world. Spencer's critics have urged that it is by no means general that the heterogeneous is more stable than the homogeneous. Under certain circumstances this may be true; under other conditions, the reverse is true. Spencer indeed realized this fact, but he regarded progress toward an increasing heterogeneity as a predetermined tendency deducible from the persistence of force. Yet such progress could hardly go on forever. Eventually its increasing complexity generates its own nemesis, and a stage of dissolution follows. Periods of evolution and dissolution throughout large parts of the universe were conceived to follow each other in a perpetual rhythm, both processes being the inevitable consequence of the persistence of force.

Fechner made no reference to Spencer, owing perhaps to his impaired eyesight which, as he explained, prevented him from reviewing the extensive literature on evolution and from making references to the work of other authors. He also made no mention of the second law of thermodynamics, but his stability principle, according to Petzoldt and Jensen, who have attempted to develop it further, is a logical consequence of that law. Whether or not such a conclusion follows, it is evident that he regarded his principle as a fundamental law of causation. Fechner was a strict parallelist. He also espoused the cause of teleology and mechanism at the same time. Speaking of the relation of the teleological principle to uniform causality, he remarked: "Since the tendency to stability in the sense of a causal principle is realized through the uniform influence of forces, this fact affords the ground for the often overlooked

harmony of both principles in the physical realm since they differ because, in the causal principle, one is concerned with the ground, and in the teleological principle with the end of one and the same uniform process."

Concerning the relation of stability to purposiveness, Fechner stated that "In fact, when we consider the matter closely, we designate the structures and outer conditions of an organism as adaptive only so far as they lead to an approximately stable state and enable it to maintain itself with more or less modification; for the death of an organism in its material aspect results from the loss of stability. Hence the principle of the tendency to stability coincides with the teleological principle so far as this relates to the material side of the organic world." Fechner, therefore, was persuaded that it was quite possible for him to conceive of evolution as determined by physical principles and at the same time as governed by ends.

Spencer, like Fechner, made no mention of the second law of thermodynamics, because, in his case, the law had not been formulated when he wrote his *First Principles*. Since, however, he spoke of "the integration of matter and the concomitant dissipation of motion" as essential features of his general law of evolution, it is evident that his standpoint has much in common with that of the upholders of the stability principle, although, so far as I am aware, none of them has mentioned him in this connection.

Most of the upholders of the stability principle, whether they have based it specifically on the law of entropy or not, seem to have labored under the impression that they were advancing an entirely original view. To an unusual degree their theoretical formulations, with few exceptions, have at least the appearance of independent efforts. Fechner (1873), as before stated, made no reference to Spencer. Nägeli (1884), in his discussion of entropy, referred neither to Spencer nor Fechner: Le Dantec (1910, 1913) did not refer to Spencer, Fechner, or Nägeli; Petzoldt (1894) considered only Fechner in his discussion of stability; and Blum (1935) has made no mention of any of the preceding names. All of these writers have attributed evolution largely to physical causes which make for stability in both the living and the non-living world.

In support of this generalization, which has made a strong appeal on account of its all-inclusiveness and the possibility of deducing it from basic

physical laws, one may readily point to the tendency of material throughout the universe to form more or less stable aggregates, both static and dynamic. Atoms, instead of being indivisible as their name implies, are found to be groups of various units clustered in the nucleus and surrounded by electrons buzzing around at tremendous speed. Ordinarily stable in their composition, atoms may lose or reacquire one or more of outer electrons, and under the influence of very powerful agencies they may be broken asunder or subjected to other changes in their composition. The number of ways in which the components of atoms can be united to form more or less stable bodies is apparently strictly limited. Disregarding isotopes, the ninety-odd kinds of atoms which are known and which fit into their definite places in the periodic table may be looked upon as resulting from the possibilities of combination determined by the properties of their constituent units. Fechner, were he acquainted with the findings of modern physics, would doubtless have derived much satisfaction in applying his "principle of the tendency to stability" to the atomic world.

Similarly, the different ways in which atoms can be combined to form more or less stable molecules may be regarded as limited by the properties of their component atoms. Aside from the compounds containing carbon, which may be loosely described as almost infinite, the number of possible combinations of most elements is not very great. Some elements form very few compounds, and a few of them, such as helium and argon, even none. Chemists have made much progress in explaining these striking differences in terms of atomic structure. The periodic law, at first an empirical generalization, has been given a rational interpretation in the same way. In the light of knowledge of atomic structure, chemists are now able to predict certain properties of compounds in advance of their formation, so that these properties no longer need to be looked upon as mysterious emergents.

Neither among atoms nor molecules are there any bodies which are absolutely stable. Were Fechner alive today he could look upon everything in the universe as in a Heraclitian flux in which there is a widespread tendency to form more or less stable bodies. On the average, this tendency is favored by the dissipation of energy in the form of heat. And this fact, of itself, often gives rise to a kind of evolutionary process. The relatively

stable, moving equilibrium of the solar system has long been cited as an illustration of an evolution produced in this way. The movement of molecules at low temperatures to form crystals, and the aggregation of crystals into the beautiful six-sided snowflakes or frost patterns that simulate the forms of plants upon windowpanes in winter, are processes that exhibit formative activities which are dependent upon an increase of entropy. The conditions for the formation of stable bodies, however, vary greatly with different materials. Many substances require a fairly high temperature for their production, and in general whether a given compound is stable or not depends upon surrounding conditions. Ordinarily, hydrogen and carbon monoxide are fairly stable gases. Under proper conditions of heat and pressure, in the presence of metallic catalysts of simple chemical composition, these gases may unite to form various alcohols, ketones, and other organic compounds which vary with the degree of temperature and pressure and the nature of the catalysts employed. A special environment like that supplied by the tissues of a living organism doubtless affords the conditions in which certain very complex proteins are able to maintain a fairly stable composition. Within the bodies of organisms the union of micelles to form fibers, lattices, and colloidal configurations carries further essentially the same kind of a process and may be looked upon as playing an important role in building up many types of intracellular structure.

Thus the fact of the tendency to form stable bodies, exhibited in both the living and the non-living, affords one of the chief supports of the theory which would interpret the whole course of evolution as flowing inevitably from the tendency toward increased stability. In applying this principle in the biological realm, Fechner was led to look upon the whole evolution of organic life as predetermined by the properties of his original organic molecules; and he also assumed that the different species of plants and animals are the products of independent lines of descent which trace back to the ultimate living units. It is noteworthy that Carl Nägeli, the chief proponent of orthogenesis from internal causes, was among the few biologists who have advocated a similar view (1884). Nägeli attributed evolution chiefly to a *Vervollkommungsprinzip* (commonly translated "perfection principle"), by which species are produced with a minimum of branching, along

separate lines which originated at different times by spontaneous generation. He strongly repudiated the idea that this principle is vitalistic; on the contrary, he contended that it operates in a purely mechanical fashion. He attributed the driving force of evolution to the law of entropy. "In general," Nägeli remarked, "the tendency toward a definite modification is based upon the second law of thermodynamics, or the law of entropy of Clausius." Our whole world transforms unceasingly toward a maximum of entropy and "the law of entropy gives a specific direction to phylogenetic development." Through its action it was held to give rise to a hierarchy of objects of increasing complexity from atoms, molecules, and micelles up to a complex network of idioplasmic strands. The forces involved in inorganic evolution thus inevitably lead on to the production of living matter, which continues the same trend and gives rise to definitely directed lines of evolution in the living world.

Those who attribute the chief impetus of evolutionary advance to internal causes, whether these arise from the law of entropy or some other factor, are prone to relegate natural selection to the minor and negative role of merely eliminating the unfit. But with evolution from internal causes taking much the same course whether selection occurs or not, as Nägeli and Fechner contended, the origin of adaptation becomes a serious difficulty. Fechner's attempt to grapple with such problems as those presented by the mutual adaptations of flowers and insects led him to adopt a very fanciful assumption. Holding the view that different species are produced by internal factors along lines whose direction is determined by the constitution of the organic molecules from which they originated, he postulated that all forms of life were related in their evolution, much as the parts of an organism are integrated in the course of their development. They are all parts of the earth, which he looked upon as one great inclusive organism. Fechner was not often dismayed by the logical consequences of his speculations even if they led him to adopt some mystical standpoint, as is shown in a number of his other theoretical adventures.

Nägeli also encountered difficulties with the problem of adaptation, on account of his assumption of independent lines of evolution determined by his *Vervollkommungsprinzip*; and his method of dealing with it, while less fantastic than that of Fechner,

ner, caused him to have recourse to highly questionable assumptions. In the first place, he was led to minimize the extent of adaptive modification by limiting it to small changes effected by the organism's own power of making appropriate direct reactions to surrounding conditions. And he also assumed that these changes, if long continued, can impress the idioplasm and be transmitted to the progeny. Speaking of the device by which the flowers of *Primula* secure cross-fertilization by having the anthers and stigma at different heights, he assumes that these organs were situated originally at the same level and that "the beginning aversion to self-fertilization effects in the idioplasmic strands which are determinative of spatial arrangement, a separation into two primordia, and, in consequence of the virtual repulsion, a separation of these primordia from each other, or at least a separation of the unfolding organs." This smacks of Lamarckism, and that, moreover, in one of its most questionable features in attributing adaptive modification to the direct effect of an organism's needs.

In minimizing the extent of adaptive changes in organisms and in attributing what little there is to very improbable causes, Nägeli rendered his position very vulnerable to the trenchant criticisms which Weismann urged against it. Adaptive modifications, as Weismann pointed out, are often very far-reaching, as is well illustrated in the extensive transformation required to convert a terrestrial mammal into a whalebone whale. The same fact is shown by the numerous parasites such as *Sacculina* which have undergone very extensive modification fitting them to live upon or within a particular host. On every hand we find organisms which have obviously undergone profound changes in relation to other organisms. In fact, the whole picture of the world of life is such as to indicate that the forces which have guided the course of its evolution have ever operated in an opportunist fashion.

In his treatise on *Organische Zweckmässigkeit*, Jensen applied the stability principle in the effort to throw light upon the causes of evolution and embryonic development. He rejected Lamarckism and strongly opposed all appeals to non-mechanistic factors, but, while conceding great importance to natural selection, he hailed the stability principle as affording a welcome deliverance from many serious difficulties for which he considered Darwin's theory to offer no adequate solution.

Like Nägeli and Petzoldt, he ascribed the major causes of evolutionary change to the second law of thermodynamics as a means of explaining the increasing complexity of life, both adaptive and non-adaptive. Even injurious characteristics, according to Jensen, fall under his theoretical explanation equally well. Variation from inner causes was admitted to result in many relatively unstable forms that fall by the wayside. As a result of this elimination, which has gone on ever since the beginnings of life, the "evolving living systems continually keep in the closest accord with the factors of the environment, so that nothing but adaptation can result, . . . we cannot expect it to be otherwise, therefore, than that the present variability of organisms thus derived keeps in general within the limits of adaptive capacity or the possibility of stable maintenance." Granting that there has long operated a tendency to progressive variability (*fortschreitende Variabilität*), it is evident that all but a small proportion of departures from type are still bad from the standpoint of survival. Whether such a progressive tendency would be expected to follow from the law of entropy will be discussed briefly further on.

The most elaborate application of the concept of stability to evolutionary theory was made by Le Dantec in his *La Stabilité de la Vie* (1910). His treatment throughout was deductive. Having defined life as essentially assimilation, under which term he would subsume habit formation (*assimilation fonctionnelle*), he stated that "by a logical series of deductions from the basic notion of assimilation characteristic of life, one is able to infer the necessity of the transmission of acquired characters. In taking as a point of departure, in addition to the fundamental notion of assimilation, other notions almost equally general . . . one can establish by a series of deductions which recall the sequence of theorems in geometry, the necessity of other laws governing directly all the particular facts of the natural sciences."

In order to afford a foundation for his biological deductions, Le Dantec devoted a good part of his volume to the physical principles from which the tendency to stability is derived. Organic evolution he regarded as an expression of the "law of progressive stability." Any variation that adds to the stability of the organism renders it more apt to survive. Le Dantec did not hold that the more stable variation necessarily produces a more complex organism. A degenerate parasite may

have more stability than its more highly organized progenitor. Since evolution is always in the direction of greater stability, whatever direction it takes, variation becomes more and more restricted as evolution proceeds. Hence a certain rigidity, analogous to senescence, tends to settle down upon the world of life and causes its evolution to slow down as it leads to the production of more stable forms. A similar tendency for variation to become more restricted in the course of evolution has been postulated by a number of orthogenestists who have attributed evolution to internal causes.

Le Dantec, although a confirmed Lamarckian, was less hostile to the theory of natural selection than most proponents of orthogenesis. Perhaps this was because he could so readily construe natural selection as the persistence of the more stable variations. Lamarckism and Darwin's selection theory he regarded as not so much opposed as complementary, the one giving a rational explanation of the causes of variation, the other accounting for the accumulation of those variations which are best adapted to the conditions of life. But the great merit of the Lamarckian view, in Le Dantec's opinion, is that variations result from the ability of the organism to adjust itself directly to environmental changes. Organisms form useful habits, a process which he called functional assimilation, and which he regarded as a basic property of life as he defined it. Hence he concluded that we may "state in advance as a necessary conclusion from the definition of life that the hereditary patrimony of a species which would vary in the Lamarckian fashion would become more stable by the very fact of its having varied. This is the statement of the law of progressive stability of living species." Once in possession of this "law" deduced from the proper definition of life, Le Dantec was persuaded that the solution of many biological problems becomes very much easier.

This law of progressive stability, according to Le Dantec, has a purely physico-chemical basis. When one variation is substituted for another in the course of the life process, "one finds the biological equivalent of the thermo-chemical principle of Berthelot: Of two possible reactions, that which is produced is that which releases the greatest amount of heat, the heat being a necessary condition of the phenomena; of two vital phenomena which are equally possible, that which is produced

is the one which releases the most vital energy, and which consequently, fulfills most perfectly the conditions of continuing phenomena."

Le Dantec claimed that the principle which he had deduced "makes it possible to derive from Darwin's natural selection not a truth *a posteriori*, as the English naturalist has done, but an *a priori* truth, a general law applicable of necessity to everything that lives." This *a priori* law was held to apply widely in the non-living world as well, as he attempted to show in a subsequent volume, *La Petite Universelle*. Having supplied a deductive basis from which natural selection as well as the Lamarckian factor may be derived *a priori*, Le Dantec was able to declare that "the notion of natural selection thus receives an importance far surpassing the limits of biology."

Another attempt to apply the principle of entropy in the interpretation of evolution has been made by Harold Blum (1935), who is convinced that the reason why biologists in general have failed to adopt the theory of orthogenesis "has been the failure, thus far to demonstrate the existence of the necessary directing factor outside of theological doctrine." Blum, one may infer, is not a Lamarckian; he is convinced that natural selection is of great evolutionary importance in eliminating non-adaptive variations, but since he conceives that Darwin's theory presupposes the occurrence of chance mutations in all directions, he holds that it does not adequately account for the tendency of evolution to follow definitely directed lines. This tendency, he believes, "would seem to be afforded by the second law of thermodynamics." Hence "the series of mutational steps, $A \rightarrow B \rightarrow C$, is alone possible and that the reverse order of occurrence is impossible, or at least much less probable." However, mutations do sometimes occur from $B \rightarrow A$; while to conclude that because the direction of variation is more frequently from $A \rightarrow B$, it must be due to the law of entropy, is a very hazardous inference. If the variation B, for instance, is caused by the loss of a chromosome, or even a small deletion, one would not expect that B could give rise to A. But if we consider only mutations in single genes, the probability of return mutations would depend on the mechanisms involved in mutational changes. It is now rather clearly established that so-called gene mutations are frequently correlated with chromosome breaks at or near the loci to which the mutant genes have been assigned, followed by the joining of the

broken end with a locus from a different chromosome or a different part of the same chromosome. This produces the so-called position effect, which is brought about as a sort of mechanical consequence of breaking and rejoining. From this viewpoint a return mutation would involve a break not only in the same situation as before, but also a break elsewhere at a particular locus which would enable the original parts to be brought together in their previous relation. From the nature of the case this would be a relatively improbable event. It is evident, I think, that the attempt to apply the second law of thermodynamics to cases like this can hardly be fruitful.

It may be claimed that many gene mutations are caused by chemical changes in discrete genes instead of position effects which result from rearrangements. But granting that such changes occur, which seem probable a priori, we still do not know whether they are more likely to occur in any one direction than in the opposite one. There are certain directional tendencies observable in mutation. Some mutations are much more prone to appear than others. An albino, whether due to a loss mutation or not, does not produce a black animal, but a black animal may produce an albino. The directions followed by variation, while obviously very numerous, are not unlimited. This would seem to follow whether mutations are due to position effects, to chemical changes in individual genes, or to the varied combinations of characters observed in Mendelian segregation. Theoretically the law of entropy can find a reasonable field of application only in the second of these possibilities. However, this law is an expression of the fact that changes involving a transfer of energy result *on the average* in an increase of entropy. Many reactions, as Blum has stated, lead, as in the familiar phenomena of photosynthesis, to the reverse effect, that of building up compounds of greater available energy than their original components. Such reactions are common in the synthetic processes of living organisms, even though the net effect of all their activities is to increase the entropy of the universe. Just what kind of a reaction from the standpoint of thermodynamics is concerned with the production of a gene mutation it would be hazardous to assume.

Much remains to be learned concerning the causes of mutations. So far as these causes have thus far been revealed, they have been found to be some kind of external influence. Whether the

germinal mutations that arise are associated with an increase or decrease of entropy we simply do not know; and we are hardly in a position to judge of the probabilities. Whether or not variation tends to follow definitely directed lines as a result of internal causes is a question upon which biologists are far from being agreed. Many evolutionists, especially among the paleontologists, have been strongly convinced of the existence of such a tendency, whatever opinion they hold regarding the efficacy of natural selection. In the group of biologists who are persuaded that they have found such a tendency in the principle of stability based on the law of entropy one possibly should include L. S. Berg, who has amassed a striking collection of facts indicative of orthogenic trends. Although a Lamarckian and a teleologist, Berg has remarked in the few words he accorded to the subject of entropy that "according to the doctrine of contemporary physics, all the processes which occur in the inorganic world have a determined direction; or, expressed differently, that the entropy of the universe tends toward a maximum. . . The principles of stability and development contain elements of teleology, says Wundt (ii, p. 66). From the foregoing it is clear that our view radically differs from the position of the Darwinians who maintain that variability, upon which natural selection operates, has no determined direction." Unfortunately, so far as I am aware, Berg has made no more explicit statements of his position on this topic.

Muller, in discussing the production of mutations by x-rays, remarks that "in ordinary substances, they are known to produce chemical changes of all kinds—not simply 'break-down' processes. However, the 'break-downs' may occur oftener, as is true in general, in harmony with the second law of thermodynamics." This remark, which was not elaborated further, apparently led R. L. Berg to associate Muller and Blum in the general statement that "from the point of view of these authors the evolution of mutability takes place in accordance with the second law of thermodynamics quite independently of natural selection. In the course of accumulation of entropy, mutations become more and more rare and the quantity of energy transformed also decreases. In other words the mutation process is gradually dampened. This view, however, seems to me to be erroneous." Berg then proceeds to describe her experiments, which she interprets as showing that mutation rates may be determined by natural

selection. As to the correctness of this conclusion, I express no opinion. The relation of the principle of entropy to the factors controlling the direction and the frequency of mutations is at present a highly speculative problem which presents many possibilities of interpretation. One cannot safely argue from a phenotypic change to the nature of the mutation concerned in its production. For all that we know, even a mutation leading to the loss of a character may be due to an increase of complexity in a genetic factor and a decrease of entropy—and vice versa.

Most of the proponents of the stability principle look upon evolutionary changes as due chiefly to the very slow action of internal causes, and they are disposed to regard abrupt mutations, whether large or small, as having a relatively minor influence on the general direction of evolution. Blum is an exception to this rule, in that he apparently looks upon evolution as effected through the accumulation of mutations. He has not discussed the stability principle as such, although he has attributed evolution to the same fundamental cause as the upholders of that theory. His position seems to be more closely related to that of Jensen than to those of the other advocates of the principle of stability.

The law of entropy is, of course, manifested in the various activities that constitute life. Does it constitute the basic factor leading to the increasing complexity of living organisms? Stability is a very inclusive category, applicable to governments as well as to physical objects. A stable entity is one that endures. Hence the survival of the fittest may be construed as the survival of the more stable forms, and consequently natural selection may be regarded as among the many manifestations of the principle of stability, as claimed by a number of the proponents of this doctrine. But in considering this very simple disposition of the problem, we should bear in mind that stability may be brought about in very different ways. The stability of an ecclesiastical institution can hardly be explained as one might account for the enduring properties of a quartz crystal. The relatively stable temperature of a mammal or a bird requires the cooperation of very different functions, carried on in remotely situated organs and in response to many different kinds of stimuli. The stable running of a watch is doubtless in accord with the principle of entropy, after potential energy has been put into its mainspring

when it is wound up. Much of the activity of an organism occurs in an analogous way because energy has been put into its foodstuffs in the process of photosynthesis. The sun is the great winder of the organic watches, which also keep time in their imperfect way in their cyclical changes.

The second law of thermodynamics is a statistical generalization, and there is much evidence that events which are of essential importance for the maintenance of life result from the back eddies in the predominantly downward course of the stream of energy. Many kinds of construction involve the dissipation of energy, as in the formation of a snowflake; others nevertheless occur with the absorption of free energy, as in photosynthesis and the formation of many organic substances through the energy supplied by the breaking down of other compounds. The stability of any composite body depends upon the conditions immediately surrounding it. The mere dissipation of thermal energy affords the condition which permits other forces to give rise to many kinds of stable, and at times very complex, structures. If we may properly use the stability principle to designate the forces instrumental in the formation of molecules and crystals, in so far as they rest on a common basis, we can safely apply it to organisms only to the extent that their integrative activities result from the same physical causes. Analyses of these activities, such as those described in Cannon's illustrations of homeostasis (1939), show that the maintenance of constant states depends upon procedures quite different from those concerned with the formation of a molecule or a crystal. This fact does not imply that these varied physiological activities may not ultimately be resolved into physical and chemical components. It does mean that the maintenance of the stability of an organism is too much like preserving the stability of a government to be accounted for by the law of entropy.

Outside of the group of theorists discussed above, most of the orthogenesisists who are not Lamarckians have been quite at sea. Weismann's attempt to explain definitely directed variability by his hypothesis of germinal selection has proved to be quite inconsistent with what is known of the mechanisms of hereditary transmission, and it probably has no defenders at the present time. Many, if not most, orthogenesisists make no attempt to explain the causes of directed variability. A number

of orthogenetic trends among forms which show a gradual increase in size in successive generations have been very plausibly interpreted in accordance with the principles of relative growth, which have been ably elaborated by Julian Huxley. Here the primary factors in orthogenetic change are those concerned with the increase in size. As a matter of fact, a considerable proportion of the series which exhibit definite trends leading to apparently non-adaptive or even mal-adaptive

modification show parallel increases in dimensions. If these increases are advantageous, various associated features of a non-adaptive kind may, as was pointed out by Huxley, be looked upon as incidental results determined by the physiological factors responsible for heterogonic growth. The secondary consequences are tolerated on account of the greater importance of the primary basis of selection. How far such orthogenetic trends may be interpreted in this way is still uncertain.

LIST OF LITERATURE

- BERG, L. S. 1926. *Nomogenesis or Evolution Determined by Law*. Constable, London.
- BERG, R. L. 1937a. The relative frequency of mutations in different chromosomes of *Drosophila melanogaster*. I. Lethal mutations. *Genetics*, 22: 225-240.
- . 1937b. The relative frequency of mutations in different chromosomes of *Drosophila melanogaster*. II. Sterility mutations. *Genetics*, 22: 241-248.
- BLUM, H. F. 1935. A consideration of evolution from a thermodynamic view-point. *Amer. Nat.*, 69: 354-369.
- CANNON, W. B. 1939. *The Wisdom of the Body*, 2nd ed. W. W. Norton, New York.
- FECHNER, G. T. 1873. *Einige Ideen zur Schöpfungsgeschichte und Entwicklungsgeschichte der Organismen*. Breitkopf und Härtel, Leipzig.
- JENSEN, P. 1907. *Organische Zweckmässigkeit, Entwicklung und Vererbung vom Standpunkte der Physiologie*. Fischer, Jena.
- LASSWITZ, K. 1902. *Gustav Theodor Fechner*. Frommann, Stuttgart.
- LE DANTEC, F. 1910. *La Stabilité de la Vie. Étude énergétique de l'évolution des espèces*. Alcan, Paris.
- . 1913. *La Lutte Universelle*. Flammarion, Paris.
- MULLER, H. J. 1927. The problem of genic modification. *Verh. V. Intern. Kongr. Vererb.* Berlin, 1927 (in *Z. ind. Abst. Vererb.*, 1, Suppl.: 234-260).
- NÄGELI, C. 1884. *Mechanisch-physiologische Theorie der Abstammungslehre*. R. Oldenbourg, München and Leipzig.
- PETZOLDT, J. 1894. Ueber den Begriff der Entwicklung und einige Anwendungen desselben. *Naturwiss. Wochenschr.*, 9: 75-81, 89-93.
- SPENCER, H. 1862. *First Principles*. Williams and Norgate, London.
- WEISMANN, A. 1904. *The Evolution Theory* (two vols.). E. Arnold, London.



NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Assistant Editor of THE QUARTERLY REVIEW OF BIOLOGY, Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.

DIALECTICAL MATERIALISM AND SCIENTIFIC RESEARCH

A review of *The New Genetics in the Soviet Union*, by P. S. Hudson and R. H. Richens. Imperial Bureau of Plant Breeding and Genetics, Cambridge; Imperial Agriculture Bureaux, Penglais, Aberystwyth. 6s. (paper). 88 pp. 1946.

By Bentley Glass, The Johns Hopkins University

At the opening session of the Eighth International Genetics Congress, meeting in Stockholm this summer on July 7, the President of the Congress, H. J. Muller, spoke with fervor of the deepening clash between scientific truth and established political authority, a battle that has become intensified particularly in regard to the science of genetics. The twisting of the principles of genetics to suit political ends and the wholesale practice of "genocide" by the Nazis in their effort to eliminate minorities of whom they disapproved have outraged the conscience of humanity and led to the branding of such policies and actions as criminal. Muller turned from viewing this demoralization of scientific principle, to consider the struggle of science with authority in the U. S. S. R. He revealed that one of the conditions which the Russian authorities stipulated for the Seventh International Congress of Genetics, scheduled to be held in Moscow in 1937, was that no papers touching on human genetics were to be presented. To this impossible condition no self-respecting geneticist could agree—the Congress was held in Edinburgh, in 1939, instead.

Muller then called the roll of the Russian geneticists who have become martyrs to their scientific convictions. He decried that so-called "science" which condemns as treason any departure from the doctrine ordained by political authority. He reaffirmed the Geneticists' Manifesto of 1939 and asserted that loss of the right to establish truth by scientific methods, though in the name of a program for the betterment of man's social and economic welfare, is too great a price to pay.

As long ago as 1936, when Muller was still a guest investigator at the Institute of Cytogenetics in Moscow, the star of the agriculturist Lysenko was ascendant. Fortified in official esteem by his claims to have developed new and valuable varieties of wheat by vernalization, and to have changed the hereditary characteristics of plants by modifying their culture conditions and particularly by vegetative grafting, Lysenko and his associate Prezent attacked "Mendelian-Morganian" genetics. It was, they claimed, a delusion and a sterile intellectual pastime. Worst of all, it was, they asserted, anti-Darwinian and opposed to the truth of dialectical materialism.

In the treatise which is the subject of this review, the British authors published two years ago an objective survey of the course of the struggle. They have explained what the Russians mean by "anti-Darwinian," namely, contra pangenesis and contra inheritance of acquired characteristics; and they have also made clear the nature of the predicated harmony which must exist between "true science" and dialectical materialism. No chapter in the history of ideas seems more fateful than this accepted Marxian doctrine that material opposites or antitheses always exist in nature and that the unity of opposites leads historically to each new resolution of interacting forces, and so determines the outcome of every situation. In genetics, the doctrine appears to take the form: intrinsic nature + environment → character of organism. With this general statement few if any geneticists would differ. But agreement is not enough. One must, to be a good scientist in Russian eyes, use and apply the method of dialectical materialism in one's experimental work. Results, moreover, are to be judged not pragmatically, but ideologically. This attitude is so far from that current in the natural sciences that Hudson and Richens bend themselves crooked from leaning backwards in the effort to be fair and objective in their critique.

Hudson and Richens have examined, case by case

and experiment by experiment, the evidence upon which Lysenko bases his claim that classic genetics is unsound. Apart from dialectics and appeals to his own accepted authorities, these come to the following:

1. *The genetics of earliness.* Lysenko claims that a hybrid F_1 plant never matures later than the earlier of its two parents, and that in F_2 and later generations transgressive segregation for earliness is impossible. The evidence is against this. When the theory is qualified to hold only "under appropriate [and unspecified] conditions of existence," it becomes so elastic as to be untestable and scientifically useless.
2. *The prediction of dominance.* Lysenko's theory that those characters are dominant which are best adapted to the environment is contrary to the evidence. Lysenko's restriction of the hypothesis to early [and unspecified] stages in growth is again elastic and useless.
3. *Inevitable degeneration of pure lines.* Not proved.
4. *Rejuvenation by means of intravarietal crossing.* The evidence is satisfactory, but the varieties are not genetically pure, as Lysenko has assumed.
5. *Mutation induced by environmental factors.* May be true, but Lysenko's evidence is of little value.
6. *Non-random segregation.* "Mendelian" geneticists have established cases of this beyond doubt, but Lysenko's own evidence is not convincing.
7. *Non-segregating hybrids.* Same as for 6. These have many years ago been fitted into the frame of genetic theory.
8. *F_1 heterogeneity in crosses between supposed homozygotes.* Lysenko's results are not out of line with general genetic theory. The difficulty is to establish homozygosity beyond question, and even then mutation may produce exceptions.
9. *Differences between reciprocal hybrids.* No geneticist would dispute the existence of such differences in many instances—nor would they regard them as fatal to any of the established principles of heredity.
10. *Internal genetic variation.* Geneticists know many mechanisms that bring this about: chimaeras, unstable genes mutating in somatic tissues, somatic crossing over and segregation, etc. Such evidence does not conflict with accepted genetic theory.
11. *Mixed inheritance.* Cases of variegation, chimaera formation, cytoplasmic inheritance, virus infection, etc., are well established in current genetic theory.
12. *Graft hybrids.* Lysenko's citations of numerous experiments in which, after grafting, the hereditary characteristics of the scion have been permanently modified by those of the stock furnish his most compelling evidence. Controls are lacking for most of these experiments, however. It is imperative that such work be confirmed by other scientists, and the neglect of Western scientists to heed these spectacular claims and to confirm or disprove them promptly has given Lysenko unmeasured aid.

Intervarietal and interspecific grafts of solanaceous plants, and even grafts between tomato and *Nicotiana* or *Datura*, are reported in the Russian work, in each case leading to modification of hereditary traits, such as the production of nicotine in tomatoes, in succeeding generations.

In sum, Lysenko's evidence, with the exception of the reported effects of graft hybridization, is disproven or unconfirmed, or, where established, is not discordant with modern genetic theory at all, but only with his rather naive ideas of what geneticists regard as true.

In the second Russian conference on the genetics controversy, held in 1936 (the first was in 1929), the Mendelian-Morganian geneticists lost the day, and Muller, who had taken an active part in the defense, found it expedient to leave the country. In 1939, a third genetics conference met, and the charges against the "classical" geneticists were repeated. Nikolai Vavilov was made a special target for attack, and after the conference this world-renowned scientist was relieved of his posts and "disappeared" in Siberia.

Other "classical" geneticists, after a period of some alarm, continued their research. At the time of the study by Hudson and Richens, the situation seemed superficially so improved that they dared to express the belief (hope?) that Lysenko's influence was waning. This was a delusion.

Two weeks after the close of the Eighth International Genetics Congress, a fourth Russian conference resumed the controversy between dialectical biology and modern genetics. Lysenko reiterated his claims to have demonstrated the inheritance of acquired characteristics and denounced his opponents, including even Zhebrak, who had for years tried vainly to conciliate the parties by showing that Mendelism is not in fact inconsistent with dialectical materialism. Lysenko was completely victorious. The Central Committee of the Communist Party of the Soviet Union gave full approval to his views, and the Academy of Agricultural Sciences adopted a letter addressed to Stalin calling for the rewriting of university textbooks and the revision of courses in biology and related sciences, so as to remove all traces of *foreign* genetics and to bring all teaching into conformity with the views of Lysenko and his mentor, "the Russian Burbank," Michurin. Zhebrak recanted his heretical views in a letter to *Pravda*, reenacting the ordeal of Galileo in an earlier day. Other geneticists had already announced their complete submission to Lysenko's views. Still others were doomed. Two members of the Academy of Sciences, L. Orbeli, physiologist, and I. I. Schmalhausen, notable student of evolutionary processes, were relieved of their posts. The Institute of Cytogenetics in Moscow, headed by N. P. Dubinin, leader of Russia's *Drosophila* geneticists, was abolished. In short, research in genetics, except of the variety approved by Lysenko and guided by precepts of dialectical materialism, has come to an end.

The lines are now clearly drawn and every scientist must take his stand. In the pursuit of truth by scientific methods, is there an implicit right and obligation to follow the evidence wherever it leads? Or must one, in the interest of society, accept as unchallengeable certain dogmas, whether these stem from Church or Marx? Newton's laws of gravitation could not remain unmodi-

fied after the advent of Einstein. Must dialectical materialism and Lysenkoan heredity remain above discussion?

Hudson and Richens' critique and the translation of Lysenko's own book *Heredity and Its Variability*, made by Dobzhansky (see Q.R.B. 21: 279. 1946), should be read and pondered by every biologist.

REVIEWS AND BRIEF NOTICES

General Biology: Philosophy and Education.....	335
Biology: History and Biography.....	342
Ecology and Natural History.....	345
Evolution.....	348
Genetics and Cytology.....	349
General and Systematic Botany.....	351
Plant Physiology.....	353
Economic Botany.....	354
General and Systematic Zoology.....	356
Economic Zoology.....	361
Animal Morphology.....	364
Animal Growth and Development.....	367

Animal Physiology.....	368
Animal Nutrition.....	376
Biophysics.....	378
Biochemistry.....	380
Microbiology.....	386
Parasitology.....	389
Health and Disease.....	390
Psychology and Animal Behavior.....	397
Human Biology.....	403
Biometry.....	406
De Omnibus Rebus et Quibusdam Aliis.....	408

GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

MEANING AND NECESSITY: *A Study in Semantics and Modal Logic.*

By Rudolf Carnap. The University of Chicago Press. \$5.00. viii + 210 pp. 1947.

The biologist Joseph Woodger has shown clearly that many of the interminable controversies of theoretical biology are rooted not in factual problems but in the scientific inadequacies of ordinary language. Biologists do not yet seem to have grasped the full importance for theoretical biology of Woodger's findings. But we may expect that general recognition of the ambiguities, contradictions, and hypostatizations that are part and parcel of everyday language forms will some day lead them to explore the powerful new linguistic techniques which logicians are creating. Probably the most productive single investigator of the linguistic problems of science is the logician Rudolf Carnap, whose amazing *Logical Syntax of Language* is classic in its field. In his latest book, *Meaning and Necessity*, Carnap has developed a meticulous new method for analyzing and describing the meanings of linguistic expressions.

Logicians customarily employ a way of meaning analysis called *the method of the name-relation*. They regard expressions in a language as *names* of (concrete or abstract) entities, in accordance with the three following principles: (1) Every name has exactly one entity (nominatum) named by it. (2) A sentence is about the nominata of the names occurring in it. (3) If a name occurring in a true sentence is replaced by another name with the same nominatum, the sentence remains true.

But this simple and intuitively sound method is not a satisfactory one. The first principle (1) contains an

essential ambiguity. In certain contexts a name may have more than one possible nominatum, e.g., the name 'human' may be (and is) taken as the name either of the *class* Human or of the *property* Human. Furthermore, when we apply the second principle (2), we create a clumsy multiplicity of linguistic entities. Logicians usually construe (2) as meaning that if an expression is about a certain entity, then the expression must contain the name of that entity. Hence, in virtue of (1), to speak of two entities we require two different expressions as their names. For example, in the symbolic language of *Principia Mathematica*, Whitehead and Russell devised separate expression forms for classes (' $\hat{x}(\dots x \dots)$ ') and for properties (' $(\dots x \dots)$ '). But worse still, when we apply the third principle (3) unrestrictedly, paradoxes arise. We give a simple example: Assume as true the sentence, "Wallace wished to know if Charles Darwin was the author of *The Origin of Species*." If, in this sentence, on the basis of the true identity sentence: "The author of *The Origin of Species* is identical with Charles Darwin," we replace the description 'the author of *The Origin of Species*' by 'Charles Darwin,' the resulting sentence, "Wallace wished to know if Charles Darwin was Charles Darwin," is presumably false.

Carnap devotes most of *Meaning and Necessity* to developing a method free from the difficulties of the method of the name-relation. He presupposes two operations distinguishable with respect to a given linguistic expression: (a) the operation of analyzing the expression to grasp its meaning; and (b) the operation of investigating the factual situation referred to by the expression, with the aim of establishing factual truth. That side of the expression which (a) alone establishes he explicates by his concept of *intension*; that side of the expression which (a) and (b) together establish, he ex-

plicates by his concept of *extension*. He does not regard linguistic expressions as names at all, but as having intensions and extensions.

Consider, for example, the sentence, "The author of The Origin of Species is human," which we symbolize by ' $H(x)(Ax, os)$ '. (Completely to formalize this sentence in Carnap's notation, we would write it in the expanded form ' $(\exists y)[(x)(Ax, os \equiv (x \equiv y)) \cdot Hy] \vee [\sim (\exists y)(x)(Ax, os \equiv (x \equiv y)) \cdot Ha^*]$ ', where ' a^* ' symbolizes the null individual. For greater convenience, we use the abbreviated form.) In this sentence we see the following kinds of linguistic entities: (1) the *sentence* ' $H(x)(Ax, os)$ '; (2) the *individual description* ' $(x)(Ax, os)$ ', which is a symbolic translation of 'the one individual x such that x is author of The Origin of Species'; (3) the *predicators* ' H '—'human', and ' A '—'author of'; (4) the *individual constant* ' os '—(the book) 'The Origin of Species'; (5) the *individual variable* ' x '.

We now list the entities which Carnap designates as intensions and extensions of these various kinds of linguistic expressions. (We cannot follow here the reasoning which led him to this procedure; for this the reader must refer to the book.) Intensions of these expressions are, respectively: (1) the *proposition* The Author Of The Origin Of Species Is Human; (2) the *individual concept* The Author Of The Origin Of Species; (3) the *property* Human, the *property* Author Of; (4) the *individual concept* (the book) The Origin Of Species; (5) the *individual concept* x (the intensions of variables are of a special sort which Carnap calls value intensions.) Their extensions are, respectively: (1) the *truth-value* Truth; (2) the *individual* Charles Darwin; (3) the *class* Human, the *class* Author Of; (4) the *individual* (book) The Origin Of Species; (5) the *individual* x (the value extension of the variable ' x ').

Note how Carnap, by his method of extension and intension, avoids the troubles inherent in the method of the name-relation. First, he clearly distinguishes questions of meaning (intension) from questions of fact (extension). Second, since he abandons the name-concept altogether, he does not preserve its essential ambiguity. Third, he eliminates the unnecessary multiplication of names which arises when the name-relation is applied. In the symbolic language, for example, he employs the neutral term ' H ', whose intension is the property Human and whose extension is the class Human, and thereby renders superfluous special expressions (' Hx '; ' $(x)(Hx)$ ') for this property and its corresponding class. In addition, he shows how to translate the symbol language into an adequate word language (metalanguage) which also does not contain the terms 'property' and 'class.' Fourth, in his new method the antinomy of the name-relation cannot arise, since he does not use the concept of name; but since his concept of extension is similar to the latter in some respects, he gives special rules which govern the inter-

changeability of expressions and which prevent the occurrence of analogous antinomies.

In a short section of his book, Carnap discusses the logical modalities, that is, concepts like necessity, possibility, and contingency. These and other modalities he defines in terms of the basic concept of logical necessity. He introduces methods which permit combining the modalities with quantified variables, and outlines semantical rules for a system of modal logic.

Meaning and Necessity continues the tradition of fruitful, original research established by Carnap in *The Logical Syntax of Language*, *Introduction to Semantics*, *Formalization of Logic* and many other stimulating and provocative investigations. Biologists genuinely desiring to clarify the theoretical foundations of their science might profitably read what he has to say.

JOHN R. GREGG



SELECTIONS FROM THE ESSAYS OF THOMAS HENRY HUXLEY.

Edited by Alburey Castell. F. S. Crofts & Company, New York. 30 cents (paper). viii + 119 pp. 1948. This thin, pocket-sized book reprints a dozen of Huxley's essays, selected to represent the propagandist for science rather than the scientist per se. They range in date from the lecture "On the Advisableness of Improving Natural Knowledge" (1866) to the "Prolegomena to 'Evolution and Ethics'" (1894), and give a well-rounded picture of Huxley's notable vigor and clarity, even when he is discussing his doubts. These are essays every biologist should know, not alone because of their historical significance, but quite as much because they say with unmatched pungency many things still true or still problematical regarding the relation of science to man, both as an individual and a social being. The booklet is well printed, but the paper is, as usual in such editions, of the cheapest. Still, the collection is good value at such a price.

BENTLEY GLASS



MAN IN THE MODERN WORLD. *An Eminent Scientist Looks at Life Today.*

By Julian Huxley. A Mentor Book, The New American Library, New York. 35 cents (paper). 191 pp. 1948.

Nine essays from *Man Stands Alone* (QRB 16: 488. 1941) and four from *On Living in a Revolution* (QRB 20: 114. 1945) have been collected for this pocket book. They are: The Uniqueness of Man; Eugenics and Society; Climate and Human History; The Size of Living Things; The Courtship of Animals; The Intelligence of Birds; Science, Natural and Social; Religion as an

Objective Problem; Life Can Be Worth Living; Philosophy in a World at War; Darwinism Today; Tennessee Revisited; War as a Biological Phenomenon. Julian Huxley is by turns caustic, instructive, philosophical. He always writes well, and his ideas, agree with them or not, are stimulating. This is an excellent addition to the cheaply priced series of Mentor Books, which has done well by biology so far.

BENTLEY GLASS



LA PHILOSOPHIE DE CLAUDE BERNARD.

By A.-D. Sertillanges. Aubier, Éditions Montaigne, Paris. 42 fr. (paper). 256 pp. 1944.

The author of this book is a distinguished and highly competent professional philosopher, a member of a Catholic order, a Thomist and as such a teleologist. It is perhaps unfortunate that its reviewer is far from all of these things. Claude Bernard himself, however, was no practitioner of systematic philosophy. "As an experimenter," he wrote at one point, "... I avoid philosophic systems; but," he continued, "I cannot for that reason reject the philosophic spirit which, without being anywhere, is everywhere and, without belonging to any system, ought to reign, not only over all science but over all human knowledge."

Indeed, the philosophic spirit moved him to incorporate numerous, though often conflicting and confused, expressions of his own philosophical beliefs among his other writings. Many of these statements, together with commentary and interpretation by Sertillanges, are included in the present text, which attempts to demonstrate the fundamental similarity of Claude Bernard's philosophy to that embodied in the Thomistic doctrine.

The primary basis of comparison is derived from an analysis of Claude Bernard's interpretation of life. Bernard's great contribution to biological progress was his insistence that the "vital phenomena rest upon physico-chemical activities," that they "possess... their rigorously determined physico-chemical conditions," that the "science of vital phenomena must have the same foundations as the science of the phenomena of inorganic bodies, and that there is no difference in this respect between the principles of biological science and those of physico-chemical science."

For all his emphasis on these points, however, Claude Bernard was no mechanist nor materialist. "I admit, indeed," he wrote, "that manifestations of life cannot be wholly elucidated by the physico-chemical phenomena known in inorganic nature." And elsewhere: "physiologists can guide the manifestation of vital phenomena as physicists guide the natural phenomena, the laws of which they have discovered; but in doing so, experimenters do not act on life."

Neither, however, did he consider himself a vitalist. "Many," he said, "... assume a vital force in opposition to physico-chemical forces, dominating all the phenomena of life, subjecting them to entirely separate laws, and making the organism an organized whole which the experimenter may not touch without destroying the quality of life itself. . . . These ideas, which were current in other times, are now gradually disappearing; but . . . the so-called vitalistic adeas still remaining in certain minds are really an obstacle to the progress of experimental science."

He believed that, as a scientific determinist, he stood on middle ground between materialism and vitalism. "The spontaneity of living bodies," he wrote, "is simply an appearance and the result of a certain mechanism in completely determined environments. . . . The behavior of living bodies . . . is dominated by a necessary determinism linking them with conditions of a purely physico-chemical order." "We shall therefore define physiology thus: the science whose object is to study the phenomena of living beings and to *determine* the material conditions in which they appear. . . . It is our sole concern to study phenomena, to learn their material conditions and manifestations, and to determine the laws of those manifestations." "Vital force directs phenomena which it does not produce; physical agents produce phenomena they do not direct." "If I had to define life in a single phrase," he said, "... I should say: life is creation. . . . When a chicken develops in an egg, the formation of the animal body as a grouping of chemical elements is not what essentially distinguishes the vital force. This grouping takes place only according to laws which govern the chemico-physical properties of matter; but the guiding idea of the vital evolution is essentially of the domain of life and belongs neither to chemistry nor to physics nor to anything else. In every living germ is a creative idea which develops and exhibits itself through organization."

It is the "guiding idea," the "creative idea," that appeals to the Thomist, similar, as it is, to the *âme* in the Thomist doctrine of *composé humain* (Sertillanges' terminology). A development of this comparison is the primary enterprise of the present book.

There are various fallacies in Claude Bernard's logic, but his greatest weakness is his inability to specify what that "guiding idea," that "creative idea," represents. "First causes," he complained, "are outside the realm of science; they forever escape us in the sciences of living as well as in those of inorganic bodies." "What we call vital force is a first cause analogous to all other first causes, in this sense, that it is utterly unknown."

For the Thomist this is no great difficulty: his soul may be metaphysical, his directive agency may be divine. For some scientists, this may be a possible escape from their dilemma, but it is not necessarily the exclusive one for all scientists. The quotations already

cited indicate how uncertain Claude Bernard was as to his own choice. These are no matters of fact, but of conviction. Each scientist must decide for himself whether to retreat to the metaphysical, and even whether he considers the Thomistic interpretation of Bernard's thought valid or not.

Claude Bernard's own concern for freedom of decision was one of his major characteristics as a philosopher. He had a kind of obsession with freedom. His interest in the constancy of the internal environment was an interest in its significance as a condition of the free and independent life. "Living machines are . . . created and constructed," he wrote, "in such a way that, in perfecting themselves, they become freer and freer in the general cosmic environment." He was an ardent believer in free will, and opposed his "scientific determinism," which guaranteed it, to the "philosophical determinism" or fatalism which negated it. "Fatalism [philosophical determinism] assumes that the manifestation of any phenomenon is necessary and independent of its conditions, while determinism [scientific determinism] is the condition necessary to a phenomenon, whose manifestation is free." "Determinism," he asserted, "far from being a negation of moral liberty, is on the contrary a condition necessary to it as to all other vital manifestations."

But freedom, on the one hand, and school and system, on the other, are not always compatible; and this is as true for neo-Thomism as for other systems of thought. "I think that the best philosophic system," said Claude Bernard, "consists in not having any." The contemporary scientist holds a position in society where he is increasingly called upon to relate his own thinking to a larger philosophy. The biologist who is concerned with this obligation will find this interesting and well-written book highly stimulating. He will find it the more valuable, however, the more seriously he takes heed of Claude Bernard's forewarning to "biological science and experimental medicine . . . against invasion and domination by systems; because sciences submitting to these would lose their fertility and would abandon the independence and freedom of mind essential to the progress of humanity."

It is always a pleasure and a privilege to consider what Claude Bernard has written, and experimental biologists, deeply indebted to him as we are, must be profoundly moved by his thinking. His position may not always be consistent; it may not always even be clear. Indeed, he may beg the ultimate question, and yet he furnishes us with a hope for the future. He has set the task for the biologist of the future who can more successfully than he himself avoid the metaphysical escape, and yet find a way to analyze the apparent directive agencies "essentially in the domain of life," as well as through chemistry and physics. He gives confidence, too, that the accomplishment of such a task need not necessarily entail the sacrifice of a philosophi-

cal foundation for that moral liberty which is the necessary condition for further human progress.

JANE OPPENHEIMER



EVOLUTION AND ETHICS.

By Sir Arthur Keith, with a Preface by Earnest A. Hooton. G. P. Putnam's Sons, New York. \$3.00 x + 246 pp. [1946] 1947.

This is an American edition of the book previously reviewed under the title *Essays on Human Evolution* (Q.R.B. 23: 48. 1948.) The present title seems more accurate than the original one. The American edition also includes a brief Introduction by E. A. Hooton, who lauds Keith as anthropologist and teacher but is non-committal about the validity of Keith's point of view in these essays.



LIFE AND MORALS.

By S. J. Holmes. The Macmillan Company, New York. \$3.00. xii + 232 pp. 1948.

Like Darwin, Wallace, Huxley, and many a biologist since, S. J. Holmes has become deeply concerned with the relation of the theory of organic evolution to ethics. He would not, I think, take umbrage at the characterization of his thoughts on the subject as critical and eclectic, rather than original. He owes much to the earlier thinking upon this subject of Darwin and Herbert Spencer, W. E. Ritter, Westermarck, W. K. Clifford, Reinhold Niebuhr, and numbers of others. Yet in all fairness one may say too that in certain respects he transcends the grasp of any of these, inasmuch as he has the accumulated knowledge of years spent in active participation in the development of present-day biology.

Holmes traces altruism to "deep roots" indeed. Even in the simplest living beings, and even in cells, the activities of life center about the two ends of "the maintenance of the individual and the perpetuation of its kind. In all life these are the primal roots of both egoism and altruism. . . . [They] are coeval instead of successive developments." This being so, it is easy to trace the evolution of the moral forces, by successive stages of reproductive concern, care for the young, and social cooperation, up to human levels. Religion becomes the handmaid of morals, not the source. Decisions upon controverted questions of right and wrong, such as divorce, birth control, euthanasia, and "vivisection," become relative rather than absolute, to be decided upon the balance of good and ill in its consequences and not upon a priori principles held to have general validity. Like Sir Arthur Keith in his recent book, *Essays on Evolution*, Holmes adopts Herbert Spencer's distinction between the "ethics of amity" and the "ethics of

enmity," both of which are generally operative. But Holmes thinks with far greater clarity on the subject than his compeer, and does not reach the unfounded conclusion that because enmity and war have been mighty forces in human history, they must therefore continue to be so, even though conditions are vastly different. On the contrary, Holmes is of the opinion that, although war may be morally justifiable under certain circumstances, we must distinguish between the conflicts of primitive people and modern states. "Viewed purely as a problem of evolutionary biology . . . the case for the evolutionary value of war is certainly far from sufficiently clear to make warfare a moral duty which we owe to future generations." Our moral horizon is still expanding, and as we begin to comprehend the worldwide character of our task to adapt the social order to human needs, we must, in spite of pessimistic forebodings, work to improve both our social environment and our genetic heritage. The national groups whose existence threatens us with war are the acme of our group egoism, against which our group altruism must strive. We indeed owe gratitude for so stimulating an expression of an elder biologist's moral philosophy.

BENTLEY GLASS



NEW BIOLOGY. Numbers 2, 3, 4.

Edited by M. L. Johnson and Michael Abercrombie. Penguin Books, Harmondsworth, Middlesex. 1s. (Nos. 2, 3); 1s. 6d. (No. 4). 158 pp. + 8 pl., text ill.; 176 pp. + 16 pl., text ill.; 160 pp. + 16 pl., text ill. 1947; 1947; 1948.

These fine examples of science writing for the general public contain the following articles: Number 2: The War against Rodents (A. Barnett); The Biology of Sewage Disposal (Ll. Lloyd); Whales (R. F. Ewer); The Chemical Basis of Competition between Microorganisms (P. W. Brian); Weeds of Cornfields (Winifred E. Brenchley and H. C. Long); Bat 'Radar' (R. H. Knight); On Cutting Your Finger (M. Abercrombie). Number 3: How a Grasshopper Becomes a Locust (B. P. Uvarov); Forage Plants (D. H. Robinson); The Menace of the Roundworm (G. Lapage); Animal Life in Caves (R. S. Hawes); The Electron Microscope and Biological Research (V. E. Cosslett); The Biology of Ship Fouling (K. A. Pyefinch); Beasts of Burden (A. Parker). Number 4: Hybrid Vigour (E. Ashby); Are Statistics Really Vital? (R. B. Fisher); Insect Menace to Stored Products (J. A. Freeman); The Biology and Properties of Wood (E. W. J. Phillips); Vital Statistics of Fish Population (G. L. Kesteven); Milk: its Formation and Secretion (F. H. Malpress); Human Teeth and their Decay (Shirley Hughes). The rotogravure plates add much to the illustrations. Teachers of general biology will find here many interesting facts and relations that will appeal to students.

RÉCENTS PROGRÈS DES SCIENCES BIOLOGIQUES (EMBRYOLOGIE, CYTOCHIMIE, GÉNÉTIQUE ET BIOCHIMIE) AUX ÉTATS-UNIS. *Actualités Biochimiques, Number 9.*

By Jean Brachet. Éditions Desoer, Liège; Masson & Cie., Paris. 60 fr. (paper). 52 pp. 1947.

The justification for this little booklet lies in the eagerness of scientists in European countries isolated almost completely during the war years to become acquainted as quickly as possible with progress made in the United States in their particular fields of research. It is essentially a carefully compiled notebook presenting information collected by the author in the course of a brief visit in the summer of 1946 to some of the larger university laboratories and centers of research in the eastern United States. In content it ranges from mere notations of contributions made or work in progress, to well digested summaries and appraisals of the current status of problems of special interest to the author. There is no formal bibliography, but full citation of published work appears in the text.

ESSENTIALS OF BIOLOGY. *An Introductory Text-Book for Secondary Schools.*

By W. F. Wheeler. William Heinemann, London and Toronto. 7s. 6d. xii + 266 pp. + 8 plates; text ill. 1947.

"The aim of the book is to elucidate the principles underlying life, as manifested in the immense diversity of animals and plants." To attain this end, the writer has grouped the subject matter into animals, plants, and a third section, animals and plants. In order to awaken immediate interest in the student, man is taken as the first example under consideration. His anatomy, histology, and physiology are briefly discussed. Then the structure and physiology of the rabbit, frog, amoeba, hydra, earthworm, and some typical insects are described. At the end of each chapter there are suggestions for practical work with the organism under consideration. Plants are taken up in a similar fashion, with emphasis on the flowering plants. Algae, fungi, and bacteria are also included. The final part considers the relationships of plants and animals, their differences, and their environmental adaptations. Growth, inheritance, evolution, and classification constitute the remaining topics. There are a large number of illustrations, consisting of drawings and photographs, the former being original and rather good. The material is necessarily brief and in many places rather sketchy, although it is as accurate as can be possible under such a treatment. This book will probably fulfil the needs for which it was intended within the English school system.

HENRI C. SEIBERT

BASIC BIOLOGY FOR HIGH SCHOOLS.

By Carroll Lane Fenton and Paul E. Kambly. *The Macmillan Company, New York.* \$3.24. x + 726 pp.; ill. 1947.

The authors of *Basic Biology*, a textbook for high schools, have set out to select material to develop all the fundamental principles of biology, to advance from observation and general ideas to understanding, and from studies in particular fields to the application of knowledge to the lives and relationships of men, to require students to use scientific method and to enable them to acquire scientific attitudes, and to do all this within a coherent, well-organized plan and in a popular, non-technical style. Such multiple aims might well daunt anyone. The marvel is that the authors have succeeded in almost every respect. So outstanding is this textbook that, within the limits of the reviewer's knowledge, only one of the very large number now extant can be regarded as equally good (see QRB 20: 169. 1945).

There are eleven units, as follows: Living Things and Their World; The Make-up of Organisms; Groups and Kinds of Organisms; Foods for the Living World; Feeding the Animal Kingdom; Organs, Systems, and Health; Producing New Organisms; Old Characters and New Ones; How Living Things Have Changed; Communities and Control; Using the World We Live In. Within these units all fundamental principles of biology are adequately covered except those of growth and development. The embryonic period of life in a human being, or other mammal, certainly could be studied with profit at the high school level. Accuracy of statement is generally high, although exception must be taken to the consideration of osmosis and diffusion as equivalent. On the whole, the book is rather elementary in level. The better high school courses may want a more advanced treatment of the subject matter.

Each chapter is concluded with a summary of the major new principles developed in it, and is followed by fact and thought questions, exercises, projects, and references for additional reading. The illustrations, both photographs and diagrams, are well chosen, graphic, excellently reproduced. Best of all, they are clear and uncluttered by irrelevant details and unneeded labels. The glossary is full, and the definitions given are reasonably accurate (except for *osmosis*) yet non-technical. The index is adequate.

In short, here is a textbook for high school biology courses that should appeal to young minds, and prepare them equally for the problems of their future and for further courses of instruction in this field. May it have a long and very extensive use!

BENTLEY GLASS



WORKBOOK AND LABORATORY MANUAL TO ACCOMPANY
BASIC BIOLOGY.

By Paul E. Kambly. *The Macmillan Company, New York.* \$1.60 (paper). iv + 220 pp.; ill. 1948. All that needs saying about this workbook-manual, intended to accompany the textbook *Basic Biology for High Schools* by Fenton and Kambly, reviewed above, is that it is mainly of the "question-and-answer fill-in" type. A few, but by no means enough, experiments and observational studies are included. This is disappointing, in view of the superlative merits of the textbook.

BENTLEY GLASS



LEARNING GUIDE IN BIOLOGY.

By Gerald N. Bench, Veva M. McAtee, Ruth Morris, Elliott R. Downing. *Lyons and Carnahan, Chicago, Dallas, Los Angeles, Wilkes-Barre, Atlanta, New York.* \$1.05, including teacher's test booklet (paper). x + 422 pp.; ill. 1947.

This workbook and laboratory manual for high school biology courses is not prepared to accompany any single textbook, but is instead keyed for use with 20 of the better textbooks most widely used at the present time. It is well organized, with stimulating exercises and many experiments and projects, although question-and-answer fill-ins predominate. More experiments could certainly be included with profit. It is too bad to find spiremes and Kallikaks still misleading the young, but most of the material is sound.

The diagrams and line drawings are good. Some of those depicting animals, with a particular system—digestive, circulatory, respiratory, etc.—superimprinted in red, are unusual and very effective.

BENTLEY GLASS



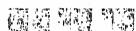
REVIEW DIGEST OF BIOLOGY.

By George M. Lash. *Republic Book Company, New York.* 25 cents (paper). iv + 120 pp.; ill. 1947. This crutch to assist ailing students over the stile of examinations is virtually worthless. It consists of definitions of biological terms and of questions based on the definitions. Many of the definitions are acceptable, but many are not. Besides which, many terms one might expect to find are absent. Hence the crutch is too short to fit under the student's arm and is made of unsound wood to boot.

The last part of the booklet contains the New York State Regents Examinations in Biology from 1942 through 1947. These are, on the whole, good examinations of factual knowledge. They may be of some use to busy teachers as well as to hobbling students.

BENTLEY GLASS

PRACTICAL BIOLOGY.



By Edwin F. Sanders. *D. Van Nostrand Company, New York.* \$3.00. x + 618 pp.; ill. 1947.

The units in this high school textbook cover the following topics: Background and Introduction; Earth Materials, Available Energy—How Living Things Use Them; Flowering Plants; The Flowerless Plants; The One-Celled Animals; Invertebrate Metazoan Animals; Vertebrate Metazoan Animals; Development, Improvement, and Elimination of Living Forms—Human Efforts to Help; Conservation of Natural Resources; Human Anatomy, Physiology, and Hygiene. There is no space given to animal reproduction, beyond a few casual references. Nor does vertebrate development receive much attention. The treatment of heredity is thin, and devoted chiefly to ethical precepts and the customary uncritical treatment of the Kallikak, Jukes, and Edwards families. Evolution is mentioned in a whisper as a "theory of race development" of whose truth the author is dubious.

The format of the book is good, and the illustrations taken from photographs have fared well; but the line drawings are frequently too small and unclear. All in all, the textbook cannot be recommended.

BENTLEY GLASS

BIOLOGY FOR SCHOOLS. *Fifth edition.*

By E. R. Spratt and A. V. Spratt. *University Tutorial Press, London.* 5s. vi + 424 pp.; ill. 1946.

British secondary school biology textbooks appear to be, as a rule, quite superior to American textbooks at the same level. They are more thorough, often more penetrating, and much less given to sugar-coating what American teachers and authors seem to regard as the unpalatable truths of biology. This *Biology for Schools*, now after 15 years in its fifth edition, would be no exception to the above rule except for one startling fact. In choice of examples, in clear explanations, in descriptive anatomy, physiology, and ecological relations the book is excellent—but from beginning to end there is not so much as a hint that either heredity or evolution exist, let alone that they constitute major aspects of biology.

BENTLEY GLASS

WE LIVE AND GROW. *Successful Living Series.*

By Seward E. Daw, Jessie F. McKee and Edna M. Aldredge; Pictures by Mildred Lyon Hetherington. *Beckley-Cardy Company, Chicago.* \$1.28. iv + 156 pp.; ill. 1947.

This child's book is the First Reader of the Successful Living Series and follows the primer, *School and Play*. The stories in this series are aimed to provide vicarious social experiences desirable for the child at his particular

age and grade level. It is hoped that these experiences will help the child to interpret life around him. In the present book the text is divided into six sections, each containing five stories. The first section includes stories of everyday living in home and school; the second is concerned with health; the third and fourth with nature-science; the fifth, with adventure and safety; the sixth, with farm life and farm animals. Nearly each page is illustrated with a color picture.

HENRI C. SEIBERT



TOWARD GENERAL EDUCATION.

By Earl J. McGrath, Paul J. Blommers, John C. Gerber, Walter R. Goetsch, James A. Jacobs, Lester D. Longman, Paul R. Olson, Goldwin Smith, Jamss B. Stroud, and L. A. Van Dyke. *The Macmillan Company, New York.* \$3.00. xii + 224 pp. 1948.

Eight professors and two deans of the State University of Iowa, all profoundly interested in the character of general education at the university level, about two years ago constituted themselves an informal group to discuss and argue their views on the subject. Out of their deliberations, after more than a year, there came this book. It is centered about the concept of the student as a future citizen, and accepts the variety and inequality of the American student group as inescapable. The most impressive aspect of the book is that these ten men, who represent fields as diverse as education, English, physics, art, economics, history, and psychology, assert that their conclusions and recommendations result from unanimous agreement.

The program outlined is well worthy of a place beside the *Harvard Report* and other stimulating discussions of recent trends and revised goals in American higher education. Biologists, quite naturally, will look with most interest on the recommendations for the natural sciences. These are summarized in the following paragraphs.

The importance of understanding the philosophy of science cannot be overstressed. To understand and use the broader techniques of scientific research, to exercise care in the analysis of results, to appreciate the use of controls, to have a complete lack of bias and absolute sincerity, and to practise self-criticism are important indirect objectives of instruction in science. More direct aims are (1) to aid in establishing physical and mental health, through a knowledge of fundamental principles and facts; (2) to recognize the impact of modern science on material progress; and (3) to understand the use of scientific knowledge in controlling and solving problems, in cultivating intellectual curiosity and creative imagination, in developing critical judgment and a sense of satisfaction growing out of successful mental activity—and, above all, in attaining freedom from fear and superstition.

These objectives naturally divide the sciences into two groups, the biological sciences, on the one hand, and the physical sciences plus mathematics, on the other. *The student must be introduced to both.* The Iowa group approves neither extensive survey courses nor segmented courses taught by members of different departments, but insists on integration. The group therefore proposes courses that emphasize *principles*, one course to be organized in the biological sciences, and two in the physical sciences (chemistry and geology; mathematics, astronomy, and physics), the student being required to take the biological course and one or the other of the two physical science courses. The organization and management of each of these courses should be the responsibility of a single individual. The classes should be small (optimum, 15 to 20 students; not over 30). Laboratory work, because it is in general so time-consuming for value gained, should to a very considerable extent be replaced by good demonstration experiments—simple, easily followed by the whole class, and yielding positive, clear-cut results. Opportunities for individual work in the laboratory should be available, but might be restricted to students really interested in learning.

The subject matter treated in the course should be rigorously selected to stress fundamental principles. Historical material should be used freely wherever pertinent and related to valid principles. The treatment of material ought to be both descriptive and analytical. Intense effort must be expended to make it interesting and living. In biology, for example, there is little excuse for time spent on classification. "The course might first consider the unit of life, the cell, and cell metabolism, then multicellular organisms and more complex forms of life, always treating living matter as a dynamic system. The major portion of the course should be given to a study of man himself and his problems, with emphasis on reproduction, nutrition, development, heredity, organic evolution, and man's mental processes." There should emphatically be units on the psychological aspects of life, and on personal and public health.

To all this, in spite of a few minor differences of opinion, I heartily assent. It is worth general note that on several campuses in the United States courses of this very sort are now being organized and given. Their success or failure will be watched from all quarters.

BENTLEY GLASS



BIOLOGY: HISTORY AND BIOGRAPHY

HISTORY OF MEDICINE. *A Correlative Text, Arranged According to Subjects.*

By Cecilia C. Mettler; edited by Fred A. Mettler. The

Blakiston Company, Philadelphia and Toronto.
\$8.50. xxx + 1215 pp.; ill. 1947.

The author has felt that instead of the usual chronological (and organic) arrangement of medical histories, a textbook should be adapted to the (arbitrary and temporary) divisions of the curriculum of our medical schools, and thus has actually tried to supply in one volume the separate histories of fourteen specialties (Anatomy, Physiology, Pathology, Physical Diagnosis, Medicine, Neuropsychiatry, Neurology, Dermatology, Pediatrics, Surgery, Gynecology and Obstetrics, Ophthalmology, Otolaryngology, and Rhinology). The results are most unfortunate and confusing. Preventive medicine, for instance, which is far more important than many of the specialties dealt with, has remained unmentioned. In view of her own numerous factual errors, the ahistorical attitude of "superiority" that the author adopts toward practically all periods and personalities of our medical past is particularly misplaced. If one adds that the author's style is indifferent, and that 1100 pages of double column printing are technically very hard to read, one will understand why the volume cannot be recommended for use as a textbook. Used with caution, it might, because of its richness of detail, be useful as a reference book to those who want to look up the history of some specialty.

ERWIN H. ACKERKNECHT



A HISTORY OF THE HEART AND THE CIRCULATION.

By Fredrick A. Willius and Thomas J. Dry. W. B. Saunders Company, Philadelphia and London. \$8.00.
xviii + 456 pp.; ill. 1948.

The authors have divided their book into three parts: 1) A history of our knowledge regarding the heart and circulation from the time of the ancient Egyptians to the first quarter of the twentieth century; 2) 20 special biographies of great "cardiologists" from Hippocrates to Sir Thomas Lewis (1881-1945); 3) a series of chronologies divided into subjects. The subtitles of Part III illustrate well the scope of the book: Anatomy of the heart and circulation; Aneurysm; Cardiac arrhythmia; Cardiovascular diagnostic signs and procedures; Congenital malformations and the embryology of the heart and circulation; The coronary vessels and their diseases; Electrophysiology and electrocardiography; The endocardium and its diseases; Heart block; Paroxysmal tachycardia; Pathology of the heart and circulation; The pulse; Surgery of the heart and blood vessels; Symptoms of diseases of the heart and circulation; Therapy of the heart and circulation.

The subject matter is intensely interesting and is competently handled by the two eminent cardiologists of the Mayo Clinic. Mistakes are surprisingly few for a work of this scope. The first five chapters are mostly compilations from standard texts like those of Garrison

or Castiglioni or Herrick's short history of cardiology, and are correspondingly impersonal. The book really gets under way with the 19th century. In these last three chapters of this part, forming three-fifths of the history, the authors evidently warm to their subject. Perhaps, then, they should have started with Harvey, just as the senior author, F. A. Willius, did in his excellent sourcebook *Cardiac Classics*. Among the biographies, those of little-known persons like Ibn-an-Nafis, Servetus, Wenckebach, Sir Thomas Lewis, etc., are most welcome, while one wonders how important the continual reprinting of such well-known lives as those of Harvey, Withering, or Laënnec may be. The chronologies on the above-mentioned subjects are so interesting and instructive that one feels that had the historical text been written in this form, that is, by making this part I, with the historical succession of facts only a chronology, and conversely had part I been made the third part, it might have produced an even more readable text. We bring this question of arrangement up only because it might serve authors faced with a similar problem of method in the future.

ERWIN H. ACKERKNECHT



ANDREAS VESALIUS BRUXELLENSIS: *The Bloodletting Letter of 1539. An Annotated Translation and Study of the Evolution of Vesalius's Scientific Development.*

By John B. deC. M. Saunders and Charles Donald O'Malley. Henry Schuman, New York. \$5.00. 94 pp. [No year].

This is, as Saunders and O'Malley rightly state, the first work of Vesalius to appear complete in an English translation. (And when shall we see the *Fabrica*?) This *Letter*, being only one of the many contributions to 16th century discussions on how to let blood, finds its importance in the fact that, in describing the azygos vein, Vesalius here for the first time clearly emancipated himself from Galen.

A most excellent introduction brings this out, and sketches the general medico-historical background of the bloodletting discussion, the early medical history of the valves of the veins, and many other important details. It reminds us of the fact that Vesalius, though the father of anatomy, was no "anatomist" (non-practising specialist) himself, but, like most of his successors up to the 19th century, received many of his stimuli to seek new knowledge from his practical medical activities. The translation itself, generously provided with informative footnotes, is no less praiseworthy than the introduction.

ERWIN H. ACKERKNECHT



PLAGUE. Laënnec (1782-1826), *Inventor of the Stethoscope and Father of Modern Medicine.*

By Arthur N. Foxe. The Hobson Book Press, New York. \$2.50. xii + 122 pp.; ill. 1947.

Under this thoroughly misleading title is offered a short novel based on the life of Laënnec, inventor of the stethoscope, and great French clinician. The novel is not bad. It is sensitive and intelligent, very lyrical, and those who like such bastardization of truth and fiction, will probably like it.

ERWIN H. ACKERKNECHT



FIGURES DE SAVANTS FRANÇAIS.

By Léon Binet. Vigot Frères, Paris. 52 fr. (paper). 118 pp.; ill. 1946.

The savants of this little publication are physiologists in whom the author has had a personal interest either through direct acquaintance, or indirectly through a mutual interest. Into the latter category falls Lavoisier, whose short biography is well interlarded with the author's own work in the field of metabolic measurements. Other biographies include those of Brown-Séquard, Charles Richet, Arsène d'Arsonval, and Charles Achard. In these short biographies, the nature of the work performed by each man occupies the major part, while the rest includes miscellaneous notes with some personal reminiscences in the case of contemporaries. There is no doubt that the author is enthusiastic about these men, for these are scarcely biographies so much as eulogies.

HENRI C. SEIBERT



L'OEUVRE DE LOUIS PASTEUR.

By Henri Simonnet, with preface by Pasteur Vallery-Radot. Masson & Cie., Paris. 220 fr. (paper). viii + 107 pp. 1947.

Here, in about 100 pages, are most competently reviewed the most important stages of Pasteur's scientific evolution: his studies on molecular dyssymmetries, on fermentations, on spontaneous generation, on bacterial diseases, viruses, and vaccines. These lucid and reliable "abstracts" of Pasteur's discoveries, freed from biographical details, will be most welcome to those who have not the time to plunge into the seven wonderful volumes of Pasteur's collected *Works*, edited by Pasteur Vallery-Radot (1923-1939), and yet who seek the contact with the thought of this scientific giant who never fails to amaze and stimulate the reader.

ERWIN H. ACKERKNECHT



LOUIS PASTEUR.

By Laura N. Wood. Julian Messner, New York. \$2.75. x + 218 pp. + 8 plates. 1948.

This is a good biography, although it does not add appreciably to our knowledge of Pasteur. Recurrent biographies of distinguished men may be of value when the individual is a controversial figure, subject to varying interpretations; or when the passage of time reveals new information. This is not the case with Pasteur, whose scientific work and personal qualities are at least moderately well known. Therefore this book may be mainly recommended to those who would like a shorter and simpler biography of Pasteur than that given in the standard work of Vallery-Radot. For young people, it should fulfil its aim very well.

WALTER C. TOBIE



A SCIENTIST WITH PERRY IN JAPAN. *The Journal of Dr. James Morrow.*

Edited by Allan B. Cole. *The University of North Carolina Press, Chapel Hill.* \$4.00. xxvi + 307 pp. + 9 plates. 1947.

At the time of his appointment as agriculturist to the Perry expedition, James Morrow was a young practicing physician in South Carolina. His observations upon truck gardening and other agricultural methods in Java, China, Okinawa, Honshu and Hokkaido, Japan gain interest and value because of his first-hand acquaintance with plantation methods and practices in the southern United States. Morrow must have been an unusually keen observer, or else in those days of very much less satisfactory interpreters he would have been seriously misled; his journal notes show him to have been remarkably accurate. The struggles Morrow experienced in trying to transport living plants by sailing ship to and from the Orient should make the reader appreciate, at least a little more, those plant introductions from which have come such a large proportion of all that we eat and wear. The author's very human observations upon Oriental and particularly Japanese characteristics and manners are also of more than ordinary interest in these days when the United States is so closely concerned with so much in Japanese life, agriculture, and government. In this connection the editor, who is a recognised scholar in his field, has rendered a particularly valuable service by setting out in a lengthy introduction the numerous reasons which motivated the United States Government to send the Perry and other expeditions to Japan.

ROBERT L. PENDLETON



HERMON CAREY BUMPUS. *Yankee Naturalist.*

By Hermon Carey Bumpus, Jr. *The University of Minnesota Press, Minneapolis.* \$2.50. vi + 10 plates; text ill. 1947.

This is a thoroughly delightful biography of one of the most inspiring naturalists of recent times. Hermon

Carey Bumpus is perfectly described by his son as "showing unusual insight and imagination in making out his problems, and clever invention and initiative in devising means for their solution." When one comes to understand the varied fields and the scope of the activities of the Yankee naturalist, one realizes how marked were his particular abilities.

As a boy in New England, his eager interest in animals and plants made his choice of biology at Brown University a thoroughly natural one, and from his enthusiasm as a student there later grew his marked talents as an inspiring teacher, not only at the same institution but also at Olivet College and at Clark University.

It is sometimes supposed that "absent minded professors" are not good business men; consequently it comes as a surprise to those whose acquaintance with Dr. Bumpus's work has been confined to his scientific achievements to learn that he served successfully as business manager of the University of Wisconsin and also as president of Tufts College, and that the present financial stability of both these institutions is largely due to his success in persuading potential patrons to contribute to the endowment funds.

But Bumpus was first of all a great naturalist. His enthusiasm over the study of living organisms in their natural environments made him a pioneer in the transformation of natural history museums from mere collections of specimens, in many instances understandable only by the curators, into the museums of today which offer so much of educational value to the public in general. The wide use of habitat groups came as a result of his creative imagination, to cite only one of the innovations which he adopted.

The opportunity to initiate such revolutionary ideas came with his appointment as assistant to Morris K. Jesup, then president of the American Museum of Natural History in New York. Before this assignment, however, he had already established a reputation by his rejuvenation of the Laboratory of the United States Fish Commission at Woods Hole, and of the Marine Biological Laboratory at the same locality.

Among H. C. Bumpus's numerous contributions to scientific theory, that one which appeals most strongly to the reviewer was accomplished while Bumpus was at Woods Hole. This was the biometric investigation of the introduced littorine, which, together with his similar investigation of variability in the English sparrow and the "mud puppy," constitutes the first use of biometry in this country as a tool for investigating natural selection.

But Bumpus is more likely to be remembered by the general public for his effort to make science readily intelligible to them. This effort expressed itself not only in the use of the habitat groups already spoken of, but also in the establishment of Trailside Museums in the national parks. To anyone who, like the reviewer,

has been in the habit of spending his vacations in national parks the importance of the Trailside Museum is obvious, for it enables one to gain an appreciation of the natural features of the countryside and an understanding of how they came to be. Bumpus's name has been given to a butte in Yellowstone Park, but his own work in science and education surely constitutes a more appropriate and more enduring memorial.

This excellently written biography by his son is of course not confined to scientific achievements, but also treats of Bumpus' ancestry, his home life, his foreign travels, his avocations, and his sense of humor. He who wishes to learn more about these phases of his life and character is most strongly advised to read the book itself.



LUTHER BURBANK, *Boy Wizard*.

By Olive W. Burt; illustrated by Clotilde Embree Funk. *The Bobbs-Merrill Company, Indianapolis and New York*. \$1.75. 188 pp.; ill. 1948.

One of a series of books depicting the childhood incidents of famous Americans, this book for children carries one through the years of Luther Burbank's youth up to his journey to California, and then, after a jump of 36 years, to a scene in Santa Rosa where the now-famous Burbank receives the homage of the local children on Burbank Day, California's Arbor Day. It is a book about a shy youngster with an insatiable curiosity and an inventive turn of mind, a youngster whose interest in plants and plant breeding carried him to fame. Well written and effectively illustrated, this somewhat fanciful biography should have a particular appeal to other children with similar inventive interests.

C. P. SWANSON



PETTICOAT SURGEON.

By Bertha Van Hoosen; foreword by A. E. Hertzler. *Pellegrini & Cudahy, Chicago*. \$3.75. viii + 324 pp. 1947.

Born in 1863 on a Michigan farm, where she was also raised, Dr. Van Hoosen has lived long and with gusto. Practising surgery for almost sixty years in Chicago, she has experienced, suffered, and helped a great deal. Many doctors tend to make life rather hard for their colleagues. What they were (and sometimes still are) able to do to a woman who had nerve enough to become a doctor and a surgeon—and a successful one in addition—is fortunately kept on record by means of this autobiography.

Dr. Bertha Van Hoosen's travel experiences, especially in China and Japan, are most fascinating. Her straightforward, sometimes almost brutal way of saying

the truth may shock some timid souls. It is actually the best part of a fine book on a life well spent.

ERWIN H. ACKERKNECHT



ECOLOGY AND NATURAL HISTORY

OBSERVATIONS ÉCOLOGIQUES EN FORÊT DE BASSE CÔTE D'IVOIRE. *Encyclopédie Biogéographique et Écologique, II*.

By Renaud Paulian. *Paul Lechevalier, Paris*. 600 fr. (paper). 148 pp. + 2 plates; text ill. 1947.

This ecological study of the tropical forest in the Ivory Coast is divided into three sections. The first describes the methods employed to gather the data; the location and description of the area chosen; certain meteorological conditions that prevail; and the characteristic stratification and type of vegetation. The second part, entitled General Ecology, describes seasonal variations in the fauna (principally arthropods); the fauna of the glades and their borders; that of the forest floor, the shrubs, and canopy. The third section is a description of the tree as an ecological milieu, with emphasis on its predation by a succession of forest insects.

The ground-inhabiting community of the clearings was found to be mostly predatory, while that of the grasses and weeds is mostly phytophagous. The former group receives its sustenance in major part from the rather dense fauna concentrated at the base of the rapidly growing vegetation. In the forest the surface was found to be poor in animal life, whereas in the intermediate zone, with a relatively stable microclimate, there exists an equilibrium between animal- and plant-consuming arthropods, although the density of the populations is still low. Many related forms which live on the ground in temperate climes are restricted here to the intermediate zone (e.g., carabids, staphylinids). The nature of the microclimate also favors considerable cryptogamic growth, with the result that the area abounds in mycophagous insects. The tree-top community is rather unique, in that most of its inhabitants are nocturnal and phytophagous. This nocturnality is especially odd, since one would expect these insects to stay away from an area of maximum light intensity.

This rather sketchy resumé of the salient points does not do full justice to all the data collected by the investigator. Anyone interested in synecology will find this a valuable contribution for comparison with other similar studies that have been conducted in forested areas of different biotic zones.

HENRI C. SEIBERT



FOREST INFLUENCES. *The Effects of Woody Vegetation on Climate, Water, and Soil, with Applications to the*

Conservation of Water and the Control of Floods and Erosion. The American Forestry Series.

By Joseph Kittredge. McGraw-Hill Book Company, New York, Toronto, and London. \$4.50. x + 394 pp.; ill. 1948.

By forest influences are meant the effects of natural vegetation on climate, water, and soil. In this book the author aims to cover the influences of woody vegetation quite thoroughly, without attempting to include with equal completeness the many important effects of range vegetation on water and soil. As the author says in his preface, "The attempts at broad generalizations based on inadequate information have been the commonest sources of the controversies of past and present. In many cases the information needed to resolve these conflicts or to clarify the problems must be quantitative. Consequently every effort has been made to bring together numerical data in support of conclusions and, wherever possible, to express relations in equations as the most useful form of quantitative generalization." Sometimes it seems as if the author is more interested in developing equations or other mathematical expressions than in the influences themselves. However, the summaries at the ends of the chapters restore at least somewhat the reader's perspective. Certainly an enormous mass of literature has been covered by the author and here presented in brief to demonstrate points of view and to show the ranges within which the forest influences have their effects. In most cases, the statement of controversial subjects is extremely dispassionate—quite as an engineer would be expected to state it: conservative, non-partisan. Most of the figures are graphs. The opening statements at the beginning of each chapter are very effective in presenting the over-all picture of the subject of that chapter. As might be expected from the engineering point of view, the author devotes much attention to the limitations of measuring devices and to showing the wide range of results which are obtained from different styles and types of rain gauges and similar instruments. The first twenty chapters of the book are basic, while chapters 21 to 25, dealing with floods, erosion, the control of erosion, vegetation for erosion control, and watershed management and the protection forest are the logical development from the preceding runoff and stream flow data. These latter chapters are much easier reading for the layman and particularly for a non-mathematical reader, for in them there is no attempt to develop mathematical statements of relationships. One is annoyed somewhat by having to refer repeatedly to the appendix to learn the botanical names of many plants which are mentioned by "common" names only. Certainly the inclusion of the botanical names in parentheses following the common names would not be as unpleasant reading as the great mass of formulae in the earlier part of the book.

This book is written for north temperate regions and

is based almost entirely upon literature from the United States. The appendix contains a bibliography of 381 items. An occasional reference is made to work in Europe or in Japan. Because of the inevitable development of tropical regions, where forest conditions and tree crops will have to be much more important in the land utilization picture than is the case in north temperate regions, it would seem that there is a place for greater emphasis upon tropical conditions. On the other hand, as yet there are doubtless insufficient data to make a discussion of the subject worth while.

ROBERT L. PENDLETON



THE EVERGLADES: River of Grass. Rivers of America.

By Marjory Stoneman Douglas; illustrated by Robert Fink. Rinehart & Company, Inc., New York and Toronto. \$3.50. x + 406 pp.; ill. 1947.

At first thought it may seem strange to discover a book about the Everglades included in the series "Rivers of America." However, the author presents convincing evidence in her first chapter that this unique region of Southern Florida may indeed be considered a river—the only one of its kind in the world—one of water and grass. The book presents a history of "the Glades" in all its aspects, from relatively brief discussions of prehistoric and modern animals and plants to detailed accounts of Spanish colonization, the Seminole Wars, and the relatively recent attempts to drain much of the area. The early historical presentation centers around the Indians in a fascinating and yet inevitably depressing tale of their long, unequal struggle against the encroaching whites—a struggle in which the white man, despite his duplicity, failed for once to gain a complete victory.

The recounting of the fate of the Everglades as a natural region under the white man's control is just as depressing a tale as that dealing with his treatment of the aborigines. The effects of haphazard drainage operations and the dyking of Lake Okeechobee, which resulted in the partial drying-up of the Glades and the disastrous fires of recent years, demonstrate most graphically the need for regional planning in the development of such an area. As the author makes clear, the only solution for the continuing problems affecting all Southern Florida lies in treating the Everglades as a single natural unit, with a development and conservation program under unified control. The timely establishment in 1947 of the Everglades National Park in the southern part of the region is a major accomplishment in such a program. But it is not the complete answer. It is to be hoped that this excellent account of the area and its history may provide the needed stimulus for the establishment of an intelligent conservation program for the entire Everglades.

NORMAN S. GILES

THE CONSERVATION OF NATURAL RESOURCES. A Textbook for Junior and Senior High Schools.

By H. Basil Wales and H. O. Lathrop. Laurel Book Company, Chicago. \$2.40. viii + 554 pp.; ill. [1944]; 1947.

This is a revised edition of a book originally published in 1944. However, on several pages one notes that the wording is still that of before V-E Day. In another place, however, the wording indicates that the section has been revised after V-J Day. In keeping with the subtitle, the book is cheaply printed on rather light paper with narrow margins. Nevertheless, for the most part the illustrations are good; however, in a number of cases more comprehensive and instructive legends could well have been used.

The authors have endeavored to inculcate the idea of conservation in all its phases, as can be seen from the titles of the "units": Unit I, Introductory Preview of Conservation; Unit II, Forest Conservation; Unit III, Soil Conservation and Agriculture; Unit IV, Conservation of the Range; Unit V, Water Resources and their Conservation; Unit VI, Wildlife Conservation; Unit VII, Conservation of Mineral Resources; Unit VIII, Conservation of Recreational, Scenic and Historical Resources; Unit IX, Carrying Conservation into Effect. Conservation in these broad aspects is indeed a very important subject, and the various topics are clearly and simply presented. At the close of each chapter is a section entitled "Activities and Experiences." If these suggestions and exercises suggested are used by the teacher, they should be very useful in relating the subject of the chapter to the actual life of the students. This book is written specifically for use in the United States. Nevertheless, it could with profit be read more widely. Hence it would seem desirable to avoid the use of the expression "white man"; this term might be replaced by the word "European" or "Caucasian" as a general term.

ROBERT L. PENDLETON



HYDROBIOLOGIA. *Acta Hydrobiologica, Limnologica et Protistologica*, Volume I, Number 1, 1948.

Edited by Gunnar Alm, H. d'Ancona, Kaj Berg, E. Fauré-Fremiet, F. E. Frietsch, K. Münster Ström, P. van Oye, W. K. Taylor, and N. Wibaut-Isebreë Moens. Published by Dr. W. Junk, The Hague. G 40.- per vol. (1 vol. of 4 numbers per annum).

The first issue of this new journal devoted to hydrobiology, limnology, and protistology contains nine papers, 5 of them in English, 2 in German, 1 in French, and 1 in Spanish, as follows: Objectionable Algae with reference to the killing of fish and other animals (G. W. Prescott); *Microcystis Toxica* n. sp., a poisonous alga from the Transvaal and Orange Free State (Edith L. Stephens); Le Phytoplankton estival de la "Costa

Brava" catalana en 1946 (R. Margalef); Algennachweis in Entenexkrementen (E. Messikommer); Thecamoebous Moss-rhizopods from New Zealand (H. R. Hoo-genraad and A. A. de Groot); Die Photosynthese des Phytoplanktons vom Gesichtspunkte der Quantenlehre (R. Maucha); On the Bohemian Species of the Genus *Pedalia* Barrois (E. Bartos); A propos de quelques espèces du genre *Trachelomonas* Ehrbg. et du genre *Strombomonas* defl. trouvées aux Pays-Bas (A. Middel-hoek); Thermal—vegetation and oecological—valences theory (V. Vouk). A final section, entitled Bibliographie, contains reviews of books and abstracts or original contributions in hydrobiology.

Four numbers, of about 100 pages each, will appear each year. Illustrations are all to be line engravings. The format and printing are excellent, the figures clear and well reproduced. It is a nuisance, however, that the pages are uncut.



NATURE AND MY CINE CAMERA. *Story and Lessons of Making Eighty Nature Films.*

By Oliver G. Pike. The Focal Press, London and New York. \$4.50. 240 pp.; ill. 1946.

Nature and My Cine Camera follows Pike's earlier book, *Nature and Camera* (1943), which summed up fifty years of his experience in photographing flora and fauna and which was then acclaimed as the most informative work on that subject. In view of Pike's wide experience in this field, the present book, pertaining to the use of the motion picture camera in photographing nature, is a welcome addition and serves to bring the subject up to date.

This relatively small volume contains the stories and lessons of making eighty nature films, each an achievement. The knowledge derived from the author's experiences will aid and benefit the cine-photographer in choosing and selecting equipment, in writing scenarios, and finally in actually obtaining or shooting the picture. A glance at the chapter headings reveals the subject matter discussed: Cine Technique; Car and Camera; Making a Nature Film; Slow Motion; Speeding up Matters; Nature Cine Micrography; and eight more chapters directly concerned with the filming of numerous and varied birds and mammals. Within these chapters the material is covered in great detail and is accompanied by illustrations of actual film strips of high quality. *Nature and My Cine Camera* fully reflects the author's great love for nature photography, and his enthusiasm carries over to the reader. This book should prove helpful to both amateurs and professionals.

JOHN S. SPURBECK



NATURE QUESTS AND QUIZZES. A *Nature-Seeker's Handbook.*

By Raymond Tifti Fuller. *The John Day Company, New York.* \$1.50. 64 pp. 1948.

This book will solve a problem for many a parent or teacher confronted with the task of keeping youngsters busy and profitably occupied. Three-quarters of the text is a directional listing of outdoor projects (a hundred of them), from finding fern prothallia or identifying four kinds of mice, to making and maintaining a woods garden or spying on a family of foxes. For those who prefer the "credit" method, a point system for competitive scoring is included. The remaining pages are given over to space for notes, and a 100-item questionnaire with (inverted) answers.

LORUS J. & MARGERY J. MILNE



ANIMAL HIDE AND SEEK.

Told and drawn by Dahlov Ipcar. *William R. Scott, New York.* \$1.50. 36 pp.; ill. 1947.

A children's book consisting largely of illustrations of camouflaged animals for the child to find. This book, while not particularly impressive, should afford some amusement to small children.



EVOLUTION

MESOZOIC FOSSILS OF THE PERUVIAN ANDES. *Ellsworth Expedition Publication. The Johns Hopkins University Studies in Geology, Number 15.*

By Maxwell M. Knechtel, Edward F. Richards, and Mary V. Rathbun. *The Johns Hopkins Press, Baltimore.* \$4.00 (paper). 150 pp. + 50 plates; text ill. 1947.

Invertebrate fossils of Upper Jurassic and Cretaceous age are described here. Most of the collections were obtained from northern and eastern Peru by expeditions led by Joseph T. Singewald, Jr., and by the Lincoln Ellsworth Expedition. Additional ammonites collected by J. A. Sinclair and T. Wasson from the same region are also described.

The work is divided into four parts. Part I includes an introduction, a list of collections, and a very complete description of collection localities. Part II, by Edward F. Richards, describes fifty-four species of Cretaceous echinoids, pelecypods, and gastropods, of which 1 echinoid, 19 pelecypods, and 3 gastropods are new. Much of the material is in a poor state of preservation and many identifications are considered tentative. Part III, by Maxwell M. Knechtel, describes 46 species of cephalopods, all of which are ammonites. Twenty-five are new species. Many of the ammonites are splendidly preserved. Part IV, by the late Mary J. Rathbun, describes a new species of a shrimp-like crustacean from the Lower Cretaceous. The descriptions are complete

and the plates are good. The photographs of the ammonites are especially commendable.

W. A. COBBAN



THE GEOGRAPHY OF THE FLOWERING PLANTS.

By Ronald Good. *Longmans, Green and Company, London, New York, and Toronto.* \$7.50. 403 pp. + 25 plates; text ill. 1947.

This closely written book contains an enormous amount of information regarding the distribution of the flowering plants of the world. It is quite impossible to do justice to it in a brief review. The author, in the Introduction, takes up the importance of plant geography, the vegetation and flora, the flowering plants and their classification, and the history of plant geography. Part I opens with a chapter on the geography of the world. Then comes one on the division of the world into floristic regions, followed by some general aspects of plant geography, including the evolutionary background, the cycle of distribution, endemism, discontinuity, age and area, and differentiation. There then follows a consideration of the distribution of families of plants: a number of different ones being taken up such as wide families, tropical families, temperate families, discontinuous families, endemic families, anomalous families. This is followed by a discussion of the distribution of genera of plants. In particular, Good discusses cosmopolitan genera, the number and size of genera, tropical genera, and temperate genera. A whole chapter is devoted to discontinuous genera; this is followed by one on endemic genera. Then the author considers the distributions of species, to include the distribution of species within genera and the significance of high species concentrations, cosmopolitan species, pan-tropical species, and other wide species, endemic species, discontinuous species, species pairs, narrowly restricted species, marine angiosperms, mangroves, and strand plants. Then, to illustrate more particularly his method of treatment, he discusses the history and distribution of the British flora, followed by the distribution of plants in an English county. He next proceeds to discuss the geological history of the world and the past distribution of the flowering plants, fossil floras, the Ice Age. The main portion of Part II is concerned with the factors of distribution: climatic; edaphic; dispersal of plants; changes of climate which have taken place in the world; and, finally, geographical changes. The author lays much stress upon the fact that for a long time prior to the glacial periods the climate of the earth seems to have been fairly moderate, almost from pole to pole. Then during the glacial epochs there was an intensification of the temperature drop from the equator toward the ice. This introduced many stresses into the previously more or less stabilized

flora. The author believes that plant distribution is best explained by Wegener's theory of continental displacement. A most interesting chapter is on the theory of tolerance, the purpose of which is to consider how far and in what manner those factors of distribution discussed can be made to provide a theoretical explanation of the geography of the flowering plants. Most helpful for the reader is the final chapter of Conclusions, which attempts to make a synthesis of all that has gone before and to present to the reader a brief but comprehensive summary of all the processes and events which have led to the state of plant distribution existing today. In the appendix are listed the discontinuous genera. There is a bibliography of 295 entries. The indexes of plant names and of persons and places seem to be unusually complete.

This book is very well and closely written. The paper and printing are excellent, and the rotogravure plates are from such well known books as Schimper's *Pflanzen-geographie* and Karsten and Schenck's *Vegetationsbilder*. The nine maps of the world are well drawn and present the facts clearly. However, their legends might be more easily read were they larger and placed in the upper right-hand corners. The numerous line drawings are clear and easily read.

ROBERT L. PENDLETON



LIFE THROUGH THE AGES. *A Visual Introduction to the Story of Change in Living Things.* Stanford Visual Science Series.

By R. Will Burnett. Stanford University Press, Stanford University. \$1.00 (paper). 48 pp.; ill. [No year].

The younger generation will certainly find its interest aroused by this evolution picture-book. It begins with a Calendar of the Ages, based on a reduction of the geological time scale to one year (7 days = 60 million years). The illustrations, each accompanied by a paragraph or page of text, are taken from the dioramas in the Palo Alto Junior Museum. They are accurate, but the animals do look rather obviously like clay models. The Carboniferous period has, for no apparent reason, been left out of the series, although it gets a sentence in the text. In addition to the series of illustrations of the typical fauna and flora of the periods, there is a small-scale reproduction of Huff and Strong's fine phylogenetic chart of the vertebrates (see QRB 18: 368, 1943), and there are graphic accounts of Diastrophism, Common Ancestry, Development through Adaptation, Peking Man, Neanderthal Man, Cro-Magnon Man, Early Cave Men, Migratory Man, Plainsmen, Lake Dwellers, the Farmer, the Migration of Races, the problems of want and suffering and the use of natural resources, etc. At the end there is a picture of the fine

building occupied by this virtually unique children's museum. The paper and print (entirely in sepia) are better suited for graphic general effect than for portrayal of sharp detail. In spite of a few flaws, however, the book makes an excellent and most welcome addition to the high school and junior high school science library.

BENTLEY GLASS



GENETICS AND CYTOLOGY

SUBMICROSCOPIC MORPHOLOGY OF PROTOPLASM AND ITS DERIVATIVES.

By A. Frey-Wyssling; translated by J. J. Hermans and M. Hollander. Elsevier Publishing Company, New York, Amsterdam, London, and Brussels. \$6.00. viii + 255 pp.; ill. 1948.

This is a translation of the author's well-known German edition of 1938, revised and brought up to date. Its importance in the field of cellular morphology is obvious, for it brings under one cover the various techniques used in, and the findings and interpretations resulting from, investigations of submicroscopic structure, together with discussions of attendant functions. It differs from the earlier edition by the inclusion of the results of electron microscopy, which as the author states have admirably confirmed and supplemented the data derived from the more indirect methods of x-ray diffraction, polarized light, double refraction, ultraviolet microscopy, etc.

The volume is divided into three sections. The first, dealing with the fundamentals of submicroscopic morphology, concerns itself with the properties of sols and gels at the molecular level. The second section discusses the fine-structure of the protoplasm, and the third the fine-structure of protoplasmic derivatives. The over-all result is a treatise that goes far in the direction of extending the field of cytology to the level of structural chemistry, a level to which cytology must go if the microscopically evident manifestations of the cellular components are to be understood in a functional sense. The reader probably will not agree with all of the interpretations of the author, but the thorough documentation, and particularly the inclusion of European work since 1938, makes the volume most useful as a reference. The translation suffers somewhat from awkward phrasing, but this in no sense impairs the usefulness of the book.

C. P. SWANSON



GENERAL CYTOLOGY.

By E. D. P. De Robertis, W. W. Nowinski, and Francisco A. Saez; translated by Warren Andrew. W. B.

Saunders Company, Philadelphia and London. \$5.50.
xii + 345 pp.; ill. 1948.

Cytology is generally considered to be a subdivision of morphology, but it is axiomatic that structure and function are inseparable. The union of cytology with genetics is but one instance of the successful blending of the functional and the structural into a single discipline, cytogenetics. The authors have taken this into account, and in this volume, which is a revised translation of an earlier Spanish text, they have incorporated the fundamentals of cellular physiology, cytology, cytogenetics, embryology, and histology. This obviously is somewhat of an undertaking, and one which can be handled only in a superficial manner in the limited space of a single volume. The treatment of these traditionally separate, but interrelated, disciplines in an integrated manner which cuts across the boundaries of the subject matter is much needed; the authors, however, have not been too successful in their treatment of the material, for, while some continuity is evident throughout the text, the subject matter is still compartmentalized to a considerable degree. Consequently, it is difficult to foresee where, within the perimeter of our usual college curriculum, such a text would find favor. It is too comprehensive for first year biology students, and too generalized to serve as a textbook for the more advanced undergraduate specialties which are usually offered. For a senior survey course or for independent reading, it has much to contribute, however, despite the brief treatment of the various topics forced upon the authors by limitations of space.

C. P. SWANSON



ADVANCES IN GENETICS. Volume II.

Edited by M. Demerec. Academic Press, New York.
\$7.50. viii + 372 pp.; ill. 1948.

If anything, the collection of seven reviews in the second volume of this series exceeds that of the first volume in interest and general value. Ernst Caspari has provided a thorough and long-needed summary of the evidence for cytoplasmic inheritance. In some cases the transmission of cytoplasmic characters is due to plastid inheritance, in others to plasmagenes or viruses. In still other cases a general quality of the cytoplasm, termed the "plasmon," is transmitted. The investigations of the plasmon show that it is not in conflict with our present views of gene behavior. Studies are now shifting to an investigation of gene effects in different plasmons. Important from the evolutionary point of view is the evidence that the plasmon is not more stable than the genes.

Gunnar Dahlberg has contributed a theoretical and mathematical review of the Genetics of Human Populations. He has studied the deviations from the basic

conditions of panmixia due to mutations, selection, assortative mating, intermarriage, and the effect of isolates. This contribution may be regarded as a briefer summary of the subject matter treated in the author's recent book, *Mathematical Methods for Population Genetics*.

A timely review of the Genetics of Cancer, by W. E. Heston, deals principally with the susceptibility or resistance to tumors manifested by inbred lines, chiefly of mice, and with mammary tumors, the milk agent, the genetic basis necessary for the growth of that virus, and the paths of gene action. Lung tumors, leukemia, subcutaneous and gastric tumors, and tumors of fowls, fishes, and *Drosophila* are treated more briefly.

The well-nigh incredible cytological phenomena found in coccids have been summarized, according to type, by Sally Hughes-Schrader. From a consideration of the coccid chromosome and its diffuse kinetochore and the probable primitive pattern of meiosis in the group, she goes on to consider modifications and types of meiosis in the female and then in the male. In the great plasticity of the mitotic mechanism in the group, in the autonomy of chromosomes and even of chromatids in cell division, the multiple strand condition of the normal chromosome, and the variations of pairing and non-pairing chromosome association, the orientation of bivalents, the prevalence of an equational separation in the first meiotic division, normal segregation after asynapsis in male llaevlines and lecanoids, the linear orientation of chromosomes in mature spermatozoa, and numerous other unusual aspects, the coccids are an extraordinary group, the study of which has already thrown new light on the nature and evolution of chromosomal and mitotic behavior, and will yield yet more in future.

Ernst Mayr has written a brief review of The Bearing of Systematics on Genetical Problems: The Nature of Species. He has considered in particular the relation of species differences to the maintenance of isolation, and those special difficulties of the species concept which are due to the existence of sibling or cryptic species among animals. He criticizes the evidence for the existence of "physiological races" and finds it weak. He holds that morphological species criteria "will have to be supplemented by a study of ecological differences and of the completeness of reproductive isolation" in cases of doubt.

E. R. Sears has surveyed the Cytology and Genetics of the Wheats and their Relatives with special consideration of genome homologies, amphiploids, autopolyploids, and haploids, and the genetic characters of the tetraploid and hexaploid wheats.

In the last review of the volume, D. G. Catcheside has summarized the vast field of the Genetic Effect of Radiations. Although this review fills 79 pages, it is rather difficult because of over-great condensation. For those already familiar with radiation genetics, it

supplies an extremely valuable summary; but for others, probably Lea's book on the *Actions of Radiations on Living Cells* will be better. Almost any one or two of the 18 major topics Catcheside has considered would make a large enough subject for a good review.

BENTLEY GLASS



GENETICS.

By H. Kalmus, in Collaboration With Lettice M. Crump. *Pelican Books, West Drayton, Middlesex.* 1s. 6d. (paper). 171 pp.; ill. 1948.

This is a book written to acquaint the lay reader with the subject of genetics. The style is good and includes the use of many interesting examples of general principles that add much to the attractiveness of the book. In addition to chapters that describe what might be termed formal genetics, a discussion of the relationship of genetics to evolution, adaptation, and to various human problems of social and economic importance is presented. A glossary of terms and suitable discussions of probability are also included. The result is a presentation that should appeal to the non-technical reader, providing he is willing to make a reasonable effort to study and understand the material offered.

JOHN E. CUSHING



GENERAL AND SYSTEMATIC BOTANY

THE ARBORETUMS AND BOTANICAL GARDENS OF NORTH AMERICA. *Chronica Botanica, Volume 10, Number 5/6.*

By Donald Wyman. *The Chronica Botanica Company, Wallham, Massachusetts; Stechert-Hafner, New York.* \$1.50 (paper). Pp. 395-484 + 16 plates; ill. 1947.

The growing interest of the American people in garden materials for home and recreational use well justifies the issuance at this time of a list of the active arboreta and botanical gardens of North America, since these gardens are the primary source of botanical information available to the general public. As a reference list for professional horticulturists and landscape architects, this one is indispensable. The list of 90 gardens is alphabetical in arrangement, and each listing provides information as to function, acreage, number and kinds of species, ownership or endowment, and operating budget, together with other miscellany of general interest. It is prefaced by an introduction on the establishment and maintenance of an arboretum or botanical garden, an undertaking the magnitude of which few individuals thoroughly understand or appreciate. Wyman has performed a needed service in compiling this mass of detailed information, and presenting it in usable form.

C. P. SWANSON

BOTANICA GENERALE ED AGRARIA: *Tecnologica e Mercologica. Volume Three, La Sistematica delle Piante. I. Parte Generale.*

By R. Ciferri. *Ulrico Hoepli, Editore, Milano.* L.450 (paper). viii + 337 pp.; ill. 1946.

The reader unfamiliar with Italian will experience no difficulty in appraising the fundamental contribution made by this textbook to general botany, and to certain of its branches in particular. Merely by glancing over its index, he will learn that the author, Professor of the University of Pavia, Italy, has dealt with the historical and scientific basis of systematic botany (Part I); the entities of taxonomy (Part II); the evolution of cultivated plants (Part III); the principles of classification of cultivated plants (Part IV); and, finally, the cultivated plants of basic importance for the modern world (Part V), which all are credited to definite centers of origin in the two hemispheres.

This, then, is a work which sooner or later will find an English translator, and deservedly. Such a work as this ranks high for the data it includes, the bibliography it contains, the field it surveys. In addition, Ciferri is a vigorous writer to whom broad surveys and detailed studies in various branches of botany are equally well known. A constructive critic will unhesitatingly welcome the publication of a textbook of this kind at this hour.

Confirmed specialists, naturally, may find now and then statements with which they cannot fully agree. This is a foregone conclusion for works that cover broad fields of knowledge and necessarily make their own the conclusions of numerous other authors. Sharp students of the International Rules of Botanical Nomenclature, for instance, will not fully approve a classification of *Olea* that subordinates the series to the subspecies, considering that said Rules assign the series to a rank between the subsection and the species. In dealing with this genus, botanists with a strong bent for historical niceties will find much to their liking in Newberry's statement (*Proc. Linn. Soc. Lond.*, 150: 3. 1937) that olive oil was pressed by certain obscure peoples of Cyrenaica shortly after 3000 B.C. The Egyptians knew these nations, and it is fascinating to speculate whether these very same nations came ultimately to migrate to Crete and Southeastern Spain. Merrill is quoted by Ciferri to the effect that the Old and New World had in common no single cultivated plant with the exception, as noticed by the latter in a footnote, of a gourd. As a matter of fact, *Gossypium* was used for the same purposes both in the Old and New World, and sound evidence indicates that the coconut might well be endemic both to the Western and Eastern Indies alike, a possibility which is thoroughly compatible with the distribution of *Cocos* as such. Merrill's main contention stands, no doubt, but the proof upon which it rests needs qualification, and that qualification entails most interesting considerations about phytogeography

in general. The reviewer looks with less favor than the author upon the conclusions of Mangelsdorf and Reeves concerning the origin of maize (reason for which is contained in an article now in course of publication).

To discuss these and similar questions in the classroom and the laboratory would be impossible, were it not that Ciferri's timely and scholarly work makes it possible to hold the subject well in hand. That this work is successful, hardly needs repeating.

LEON CROIZAT



AN OUTLINE OF GENERAL BOTANY. *College Outline Series. Revised.*

By Harry J. Fuller. Barnes & Noble, New York. 75 cents (paper). x + 188 pp.; ill. 1947.

This revised edition of a standard botany syllabus has been brought up to date through the inclusion of new information arising out of experimental work. It still, however, follows the treatment of botany characteristic of the early 1900's, and because of its inadequacy and sweeping generalizations it should be placed on the "verboten" list for botany students.

C. P. SWANSON



ROCKY MOUNTAIN TREES. *A Handbook of the Native Species with Plates and Distribution Maps. Second Edition.*

By Richard J. Preston. The Iowa State College Press, Ames. \$2.50. lxxx + 286 pp.; ill. 1947.

"The one major change in this edition has been to bring the nomenclature up to date." The latest International Rules of Nomenclature have been applied. Some few trees formerly classed as species have been reduced to the status of varieties or synonyms. The first edition was favorably reviewed (QRB 15: 489. 1940).



THE TREES OF YOSEMITE.

By Mary Curry Tresidder; illustrated by Della Taylor Hoss. Stanford University Press, Stanford. \$2.00 (paper). xiv + 134 pp.; ill. 1948.

This is a small, beautifully printed book, generously illustrated with numerous linoleum block prints. While strikingly decorative, it is unfortunate for the stranger that some of the illustrations are of very doubtful assistance in recognizing the trees illustrated. One could wish for many more line drawings than the one page which has been included, and for some good photographs in addition. The text contains much of popular botanical interest about the trees and their site requirements.

ROBERT L. PENDLETON

THE AFRICAN VIOLET *Saintpaulia*.

By Helen Van Pelt Wilson; Drawings by Leonie Hagerly. M. Barrows and Company, New York. \$2.50. 191 pp.; ill. 1948.

African violet enthusiasts, a rather recent but rapidly growing group of hobbyists, may be divided into two groups, those who can grow *Saintpaulia ionantha* with ease as well as exclaim over its beauty, and those who simply exclaim. Miss Wilson, in this first book on the Saintpaulias, attempts to remove some of the mysteries surrounding their culture, and so to merge the two groups of enthusiasts. Her success can only be measured by those who, in turn, attempt to translate her instructions into practice. The text appears certain to be greeted with enthusiasm, for the African violets are a "finicky" group which demands a particular treatment for optimum growth. The author handles the historical and cultural aspects of her subject well. The amateur, however, will have difficulty in determining what varietal name to give to a particular plant, for many of the varietal characteristics are not distinctive and clear-cut.

C. P. SWANSON



THE GENUS CREPIS. *Part One: The Taxonomy, Phylogeny, Distribution, and Evolution of Crepis. Part Two: Systematic Treatment. University of California Publications in Botany, Volumes 21 and 22.*

By Ernest Brown Babcock. University of California Press, Berkeley and Los Angeles. (I) \$4.00 (cloth), \$3.50 (paper); (II) \$12.00 (cloth), \$10.00 (paper). (I) xii + 198 pp. + 2 plates; text ill. (II) x + pp. 199-1030 + 35 plates; text ill. 1947.

The Genus Crepis is a monograph in two volumes. The first of these is a small book of about two hundred pages, in which are the "discursive" parts of the monograph, while the second is a much larger volume that contains systematic descriptions of the sections and species of the genus. The monograph as a whole is the result of many years' research and has been prepared with extraordinary thoroughness and insight. Babcock began the study of the genus in 1915 and has continued it to the present time. The initial impetus came from the recognition on the part of Babcock that the genus *Crepis* has a low number of chromosomes that are easily studied, and that here in the plant world there might be a worthy counterpart of the fruit fly *Drosophila melanogaster*. Soon after its inception, the importance of the project was recognized by the California Agricultural Experiment Station and it was made a major part of the research program in the Division of Genetics. Support for the essential continuity of the study came thereafter from the Experiment Station. The present monograph covers the results of the whole study, and

contains in one work the significant material published in many preliminary papers.

For the general student of biology, particularly of its evolutionary phases, Part I (the first volume) will, of course, be most useful and stimulating. Babcock's experience with the genus *Crepis* has been similar to that of others who have attempted large-scale cytogenetic studies of genera. He has found himself entangled in the complexities of taxonomy, and has found it necessary, as an adjunct to the cytogenetic work, to prepare a taxonomic revision of the genus. Such labors are unavoidable, not only because of the partial or unfinished state of much of the world's taxonomic studies, but also because the cytogenetic work itself gives rise to new knowledge which must be incorporated in the taxonomic revisions. Volume II contains this taxonomic revision of the genus, and will be of value principally to students of systematics, and to institutions whose work is heavily weighted in that direction. The two volumes are, however, complementary, and must be examined together if one is to assay the full import of the monograph.

The number of species treated is 196, of which 113 were grown in cultivation for cytogenetic investigation. More than 5400 herbarium specimens are cited in the taxonomic descriptions, and the author states that probably as many more were examined without being cited. Throughout the years many thousands of individual living plants were examined in the field, and the results of those field observations have become a part of the author's thinking. The taxonomic study is buttressed also by extensive examination of type material in both European and American herbaria, so that it rests upon a sound evaluation of all the material resources available.

Part I begins with a comprehensive history of investigations in the genus *Crepis*, and shows the author's development of his problem. Following this comes a chapter on the taxonomic concepts used in the study as a whole. Chapter 3 states, in considerable detail, the criteria used in classification and phylogeny. Here the author makes it clear that morphologic criteria are his basic ones. Discussions following these preliminary chapters set forth the author's views on the phylogeny of the genus, its geographic distribution, notes on Asiatic-European plant migration and its bearing on the present distribution of *Crepis*, a study of endemism in the Old World species, and finally a general discussion of the origin of migrations and the evolution of the genus. Four Appendices are added, dealing with proposed problems for further research, the bearing of the evolution of *Crepis* on the origin of the ancestors of Eurasiatic crop plants, the bearing of the distributional history of *Crepis* on the region of origin of some angiosperms, and a brief essay on ovary anatomy as a phylogenetic criterion in *Crepis*. Part I closes with a list of references and an index.

Part II gives detailed descriptions of individual species and lesser taxonomic groups, with copious notes on geographic distribution, taxonomic relationship, and synonymy. There are comprehensive keys to the genus as a whole and to various species complexes. At the end is an index to cited Exsiccatae, and also an index to generic and specific names.

The whole monograph is copiously illustrated with excellent maps, anatomical drawings, and photographs of type and other critical specimens.

H. M. RAUP



PLANT PHYSIOLOGY

CHEMICAL COMPOSITION OF PLANTS AS AN INDEX OF THEIR NUTRITIONAL STATUS. *Imperial Bureau of Horticulture and Plantation Crops. Technical Communication Number 17.*

By D. W. Goodall and F. G. Gregory. *Imperial Bureau of Horticulture and Plantation Crops, East Malling, Kent, England; Penglais, Aberystwyth, Wales.* 9s. (paper). 167 pp. 1947.

Every chemist and physiologist, whatever may be his specialty, could add to his stature as a scientist by familiarizing himself with the technics which investigators of soils and of the nutrition of plants have evolved during the course of more than a century. The relation of plants to soil composition, moisture content, temperature, and hydrogen ion concentration is a field of chemical inquiry in which great progress has been made but in which also many fundamental problems remain to be solved. The future of mankind in every habitable part of the world will be greatly influenced by the extent to which plant nutrition can be understood in chemical terms, so that crop production, a perennial problem, can be safeguarded and perfected to the greatest possible degree.

In the present volume there will be found an account of constructive thought by students of plant nutrition. The shortcomings of quantitative chemical analysis as a basis for solving problems in biology, and the necessity of employing the living plant for analytical purposes are here set forth in a fascinating story which parallels in a striking way the experiences of students of animal nutrition. The present status of the micro-nutrients in plant nutrition is clearly delineated. This book should have a place in assigned reading for all graduate students in biology, physiology, geology, and every department of chemistry.

E. V. MCCOLLUM



THE FEEDING OF CROPS AND STOCK: *An Introduction to the Science of the Nutrition of Plants and Animals. Part I. The Plant; Part II. Soils and Fertilizers; Part*

III. The Nutrition of Animals and Man. Third Edition.

By Sir A. D. Hall; (I) and (II) revised by W. G. Ogg; (III) revised by John Hammond. John Murray, London; Transatlantic Arts, New York. \$3.75 set. (I) x + 120 pp.; (II) x + 114 pp.; (III) xii + 116 pp. 1944.

Originally written by Sir Daniel Hall and published in 1911, these little books have been frequently revised. The latest edition, of which the present is a reprint, has been done under the supervision of the best agricultural scientists in Great Britain and can be considered to be thoroughly reliable. Sir Daniel's style of writing is unusual, and his books are almost worshipped by his countrymen. This is one of the reasons why unusual efforts have been made to keep this work in print. Using British terminology and illustrations, the books can hardly be considered of much interest outside of that country.

The three pocket-sized parts are designed particularly for the use of students in the agricultural short courses held in Britain from time to time for young people or adult farmers. There, such courses are known as "institutes." The work is suitable for use in connection with lectures and demonstrations. With but few line drawings and few halftones, and those poor, the descriptions of experimental procedures and demonstrations are a bit difficult for the average reader to follow.

ROBERT L. PENDLETON



ECONOMIC BOTANY

GARDENING. A Complete Guide to Garden Making Including Flowers and Lawns, Trees and Shrubs, Fruits and Vegetables, Plants in the Home and Greenhouse. Revised Edition.

By Montague Free. Harcourt, Brace and Company, and The American Garden Guild, New York. \$4.00. xvi + 550 pp. + 31 plates; text ill. 1947.

Particularly for use in the north temperate regions of the United States, this book is all that its subtitle would indicate. In so far as any one book could possibly do, it covers excellently the entire field from landscaping to aquarium plants. The author, a graduate of Kew, is fully competent and has had the best of training and experience. Certainly the British professional gardener cannot be excelled—for serious training in the art of plant propagation and all other phases of gardening there is no training that can compare with that which is given at Kew. After the reviewer had worked under two Kew graduates, he realized how inadequate is the knowledge of gardening possessed by the average American amateur gardener. American gardeners are serious and very hard working, but most of them could profit in many ways be carefully following the sensible and clear instructions given in this book. The art of

gardening in Britain is certainly farther advanced than it is here, and this book is the epitome of that art. And when one compares the gardens in Britain with those in the United States, the latter suffer by comparison with those of householders of a more or less equal position in England. There are repeated instances throughout the text where the author has added light humorous touches which make the book enjoyable reading even though one is not seriously intent upon gardening. The half-tone illustrations are superb and admirably illustrate the text. In addition, there are a great many line drawings which add clarity to the explanations. To every serious minded gardener, especially in the northern United States, this book can be heartily recommended.

ROBERT L. PENDLETON



AMERICAN HONEY PLANTS: Together With Those Which Are of Special Value to the Beekeeper as Sources of Pollen. Fourth Edition.

By Frank C. Pellett. Orange Judd Publishing Company, New York. \$6.00. 467 pp.; ill. 1947.

When the first edition of *American Honey Plants* appeared in 1920, it was the only book in the English language to deal with the source of bee pasture, and it at once became the authoritative reference work on the subject. It has already been revised twice.

The present Fourth Edition has been greatly enlarged and rewritten to include the latest information available. Over 100 new plants have been added. It is now a complete and practical encyclopedia on honey plants and furnishes not only practical information but also digests of all the important literature in the field. The plants discussed are arranged in alphabetical order, and their scientific names are adequately indexed. Some 200 illustrations and maps add much to the value and appearance of the book.

ALBERT F. HILL



COMMERCIAL FLOWER FORCING. The Fundamentals and Their Practical Application to the Culture of Greenhouse Crops. Fifth Edition.

By Alex Laurie and D. C. Kiplinger. The Blakiston Company, Philadelphia and Toronto. \$4.75. viii + 550 pp.; ill. 1948.

Successful floriculture, particularly at the commercial level, is no longer a matter of being the possessor of a "green thumb"; mass production, with its emphasis upon efficiency and economy, has demanded the application of foolproof scientific procedures which can be depended upon. Laurie and Kiplinger provide in their fifth edition (4th ed. reviewed, QRB 20: 274. 1945) an excellent basis for an up-to-date understanding of the cultural practices which have been thoroughly tested,

including recently worked out principles of gravel culture, constant level subirrigation, and disease and insect control. Provided with a bibliography at the end of each chapter, the book should be useful to the specialist as well as to the beginner in floriculture who contemplates a career in this competitive field.

C. P. SWANSON



HEALING HERBS OF THE UPPER RÍO GRANDE.

By L. S. M. Curtin; Drawings by P. G. Napolitano. Laboratory of Anthropology, San Vincente Foundation, Santa Fe, New Mexico. \$7.50. x + 281 pp.; ill. 1947.

Healing Herbs of the Upper Río Grande, dealing with the native remedies of the Spanish-speaking Indians of the Southwest, is a welcome addition to the literature of ethnobotany and constitutes a valuable contribution to cultural anthropology in general and to our knowledge of drug plants.

The investigation was undertaken with the knowledge that the rapid decline of folk experience among the present-day Indians might well result in the total loss of much valuable information. The Southwest is an especially profitable region for ethnobotanical research in that the herb lore combines tribal knowledge, derived from experimentation, with folk lore and tradition handed down through the centuries from the original Moorish and Spanish sources.

The author discusses some 225 remedies, including a few of animal or mineral origin. Her treatment of the subject, based on talks with the Indian "médicas," adequately interprets the folk quality and often indicates its Moorish background; and it is also scientifically accurate from a botanical standpoint. Herbarium specimens were made wherever possible and these have been identified by Paul C. Standley of the Chicago Natural History Museum. The botanical nomenclature has been brought up to date by Dr. and Mrs. Joseph Ewan. The book contains 30 good illustrations, a bibliography, a general index, and an index of remedies.

ALBERT F. HILL



OUR FORESTS.

By W. H. Rowe. Faber and Faber, London. 12s. 6d. 173 pp. + 23 plates. 1947.

Convinced that ignorance of forests and forestry in lay circles is widespread and relatively complete, the author set out to do something about it. *Our Forests* is the result. This little book covers a lot of ground, presenting in simple language the story of British forests—how they evolved, how they were "mastered" (and despoiled) by man, and how they may be rehabilitated and extended.

The author rightly holds that for forestry to achieve its proper place in the economy of a community there must be developed in the people a mental quality which he calls "forest-sense." Many years ago a similar view was advanced by Sir Dietrich Brandis, who reasoned that for forestry to succeed it was necessary that the people in and near the forest be for and not against it. Ignorance regarding forests and forestry should decline, if this little book receives the wide reading that it merits.

H. J. LUTZ



THE PRACTICE OF SILVICULTURE. Fifth Edition.

By Ralph C. Hawley. John Wiley & Sons, New York; Chapman & Hall, London. \$4.00. xii + 354 pp.; ill. 1946.

In this edition of his well-known college textbook, the author has attempted to revise the text thoroughly, so as to give expression to the new knowledge and the modern interpretation of old principles of silviculture. The author defines the purpose of silviculture as "the production and maintenance of such a forest as will best fulfill the objects of the owner." He then continues: "This book treats primarily of the production of wood crops and only where otherwise stated has it any other objective in view." It is encouraging to find that at least a few references have been made to forestry work in Java and India. However, since there is an increasing appreciation of the more rapid growth of trees in lower latitudes and of the fact that tree crops are almost the only way in which to utilize vast areas of poor soils in the humid tropics, it is a pity that the author has not made a greater effort to give the North American student of forestry some little notion of the importance of forestry nearer the equator and of some of the contrasting methods and practices. Certain it is that increasing numbers of North American foresters will be concerned with tropical forestry.

ROBERT L. PENDLETON



ADVENTURES IN MAN'S FIRST PLASTIC. *The Romance of Natural Waxes.*

By Nelson S. Knaggs, with Illustrations and Jacket Design by Frederic H. Kock. Reinhold Publishing Corporation, New York. \$6.75. xiv + 329 pp. + 92 plates; text ill. 1947.

Scientists have often been accused of not being able to write for the layman. Here is a book which refutes that idea. *Adventures in Man's First Plastic* is at one and the same time a fascinating story of romance and adventure and a mine of factual information. The author, a chemist and veteran traveller, has long been a student and collector of waxes and, during the recent

War, went on several expeditions in search of new sources of those substances. He is, therefore, well equipped to write the story of the natural waxes of the world.

The chapter headings give an adequate idea of the scope of the work. Expedition to the Amazon tells of the adventures of a wax expedition in the dense jungles of the Amazon basin and gives an account of caiaçu wax (from *Calathea lutea*); Wax Through the Ages traces the history and the many uses of wax from the Lost Wax of the Egyptians and early American civilizations to the present day; Brazil's Tree of Life treats of carnaúba wax; and Exploring the Big Bend and On To Mexico are concerned with candelilla wax. Other chapters include: Submarine Treasure, the Romance of the Whaling Industry and Spermaceti Wax; The Little Lady Lac Bug, the Story of Shellac and Shellac Wax; Chin-Lu and the Wax Caravan, Chinese Insect Wax; Ouricuri, the Ant Killer Tree, Ouricuri Wax; The Esparto Harvesters of North Africa, Esparto Wax; The Mysterious Bee, Famine Fighter of Mankind, Beeswax; A 60,000,000-Year Old Plastic, Ozokerite Earth Wax; Wax from an Ancient Forest, Montan Wax; and White Crystals from Black Gold, Paraffin Wax and Microcrystalline Waxes. A final chapter deals with some twenty natural and synthetic waxes of minor importance.

A technical reference section which is appended consists of a chart giving the properties of natural waxes, a bibliography, and an index. This book should appeal to the botanist, entomologist, geologist, archeologist, and chemist as well as to the non-professional reader.

ALBERT F. HILL



GENERAL AND SYSTEMATIC ZOOLOGY

ANIMALS ALIVE.

By Austin H. Clark. *D. Van Nostrand Company, New York, Toronto and London.* \$4.00. viii + 472 pp.; ill. 1948.

Austin Clark has drawn upon his wide experience in biology to present a survey of the animal kingdom from an ecological viewpoint. The first of four parts is economic zoology, with both useful and harmful aspects given thoughtful treatment. The second section, on land animals, begins appropriately on an insect note, and covers their food relationships and those of the other invertebrates before progressing up the pyramid of numbers to birds, mammals, and reptiles. Part Three deals with fresh-water animals and amphibious forms, while the final section covers marine things and sea birds. The appended classification of animals may help to keep the tyro straight, but the full index with its generic and specific names to match the popular ones used provides the systematic specialists with the proper cues. That these steps are necessary will

be appreciated at once by anyone who considers the vast variety of animals included by the author. The book abounds with factual matter—lengths, weights, shapes, colors, distribution, mode of capture, and especially food habits and uses or ecological relationships of animals. These provide a wealth of entertaining and informative reading that even the professional biologist will enjoy, while for general audiences who are not dismayed by an occasional popularized name (such as rhabdocoel), the book offers a stimulating panorama of the animals who share the earth with us.

LORUS J. & MARGERV J. MILNE



CHANTS D'OISEAUX ET MUSIQUES D'INSECTES. *Les Bois, Les Champs et Les Jardins; Vues sur le Monde Animal. VII.*

By Marcel Roland. *Mercur de France, Paris.* 75 fr. (paper). 220 pp. 1946.

Writing in the first person singular, M. Roland continues his series "Les Bois, les Champs et les Jardins (Vues sur le Monde Animal)" with the present (7th) volume of chatty description. He intersperses references to classical comments on bird and insect sounds with his personal observations and anecdotes. A little natural history and a brief mention of anatomical features related to song or stridulation are followed in most instances by syllabic representations of the notes themselves. Linguists might be interested in comparing the phonetics with similar attempts made, in England or Germany, where the same species are found—to see how French ears differ from others in their response to such natural noises. Throughout the book a light touch is maintained, whether the subject is a swallow or a cuckoo, a cicada or a dung beetle. The birds are grouped in Part One "En Forêt," the insects in the final section "Au Soleil." Scientific names are included in the descriptions themselves, but there is no index.

LORUS J. & MARGERV J. MILNE



THE SPECIES OF THE PSEUDOSCORPION GENUS CHELANOPS DESCRIBED BY BANKS. *Bulletin of the Museum of Comparative Zoölogy at Harvard College, Volume 98, Number 2.*

By C. Clayton Hoff. *Museum of Comparative Zoölogy at Harvard College, Cambridge.* \$1.00 (paper). Pp. 473–550 + 4 plates. 1947.

This revision of the species of *Chelanops* studied by Banks from 1890 to 1914 redescribes and reassigns 26 of those 28 species in the light of modern taxonomic practice, which regards Banks' original genus *Chelanops* as virtually equivalent to the present superfamily

Cheliferoidea or to the suborder Monosphyronida. The 26 species now fall into 12 genera of the two families Chernetidae and Cheliferidae, two of the genera being new.



BEES' WAYS.

By George DeClyver Curtis; Decorations by Edwin Earle. Houghton Mifflin Company, Boston. \$2.75. xii + 240 pp.; ill. 1948.

The thirty-seven years of beekeeping which back this book show clearly in the charm and philosophical comment with which the complex tale is told. George Curtis has observed closely, with less poetry but more exactitude than Maeterlinck, and his anecdotes point up the account at frequent intervals. His familiarity with and obvious respect for the bees, his intense interest in all aspects of their activities, gradually infuse the reader with an urge to get a hiveful and see these remarkable insects at first hand. The fourteen chapters provide an enthusiastic, easily-read tour of the colony, with emphasis always on the behavior of the bees themselves. So many facts in such a pleasant little book would seem to have justified an index for those who would like to check back on some half-remembered detail; unfortunately, there isn't any.

LORUS J. & MARGERY J. MILNE



LAND MOLLUSCA OF NORTH AMERICA NORTH OF MEXICO. Monograph Number 3, Academy of Natural Sciences of Philadelphia. Printed by the George W. Carpenter Fund for the Encouragement of Original Scientific Research, Volume 2, Part 2, 1948.

By Henry A. Pilsbry. Academy of Natural Sciences, Philadelphia. \$12.00. xlvii + pp. 521-1112; ill. 1948.

This is the final instalment of the work which all students of North American terrestrial mollusca have been awaiting since its first part appeared nearly ten years ago. No comparable work has appeared since Binney's *Manual of North American Land Shells* over half a century ago, and in the meantime many significant changes have occurred—changes in taxonomy and nomenclature, and published descriptions of new genera and species.

The geographic scope of this work is approximately that of Wallace's Nearctic Region, except that the southern part of Florida, which is essentially Neotropical in its zoological affinities, has been included. This step has necessitated the inclusion of several essentially Neotropical genera, such as *Cerion*, *Macroceramus*, *Drymaeus*, and the highly colored *Liguus*, whose early extinction is now threatened by its popularity with tourists.

The great value of this work, however, lies in its treatment of the more widely spread Nearctic genera. As a result of his anatomical studies, the author has been able to dismember the old genus *Polygyra* into more than a half dozen new ones, leaving a mere handful of species in the southeastern states to bear the old name. The genus *Ashmunella* of Arizona and New Mexico, and *Oreohelin* of the Rocky Mountains and Great Basin, both of which were formerly thought to be closely related to *Helminthoglypta* of the Pacific coast, are given new affiliations—the former as a modified *Polygyra*, and the latter as related to the Asiatic *Camaena*. A new suborder, the Systellommatophora, has been erected for the Veronicellidae.

The reviewer was surprised to learn what a large number of European land snails have been introduced into North America by human agency, most of them being concentrated in the vicinity of Charleston, South Carolina. (Incidentally, *Cepaea hortensis* is not one of these. This European species, today found in such numerous localities in New England, Nova Scotia, and Newfoundland, was formerly believed to have been brought over by the Norsemen but is now considered to be circumpolar in origin and distribution.)

An interesting phase of the distribution of introduced molluscs is the rapidity with which they spread. A land snail from the Mediterranean, *Rumina decollata*, has been swiftly taking possession of our southern states. The northern, eastern, southern, and western limits of its range in the United States were determined by the present reviewer in 1940. In localities where it was unknown a few years previously, it is now quite abundant.

So far, no Asiatic land snails have established themselves in this country, but since this work was published the African *Achatina fulica*, which has become a pest in Ceylon and Guam, has been reported in Los Angeles. Its occurrence there illustrates the difficulty of keeping up with events.

A fuller discussion of general taxonomy would have been welcome in the monograph, since many of the taxonomic changes the author has introduced are far-reaching and affect other families than those of North America. For instance, the old family Helicidae, of world-wide distribution, has been broken up into half a dozen or so new families, and the question arises as to which of the Old World genera may be assigned to these new families and how many additional new families will be required to accommodate those genera which cannot be.

Helen Winchester's beautiful drawings of molluscan anatomy add much to the value of this work, and the photographs by A. Delwin Warden are the best this reviewer has ever seen. Altogether this work constitutes a landmark of monumental proportions in molluscan research.

JOSHUA L. BAILY, JR.

MONOGRAPH OF THE STROPHOCHEILIDAE, A NEOTROPICAL FAMILY OF TERRESTRIAL MOLLUSKS. *Bulletin of the Museum of Comparative Zoology at Harvard College, Volume 100, Number 1.*

By Joseph C. Bequaert. *Museum of Comparative Zoology at Harvard College, Cambridge.* \$5.00 (paper). 210 pp. + 32 plates. 1948.

There is something fascinating about a snail over a foot in length when extended and crawling, whose shell may be six inches long, and whose eggs resemble in size, shape, color, and texture those of pigeons.

The author of this work has a habit of picking out unusual and interesting objects of study, and those who have accustomed themselves to think that his name on a title page is ample assurance of a treat awaiting them within will not be disappointed in the present case. The author has chosen to monograph a family of snails which flourishes on the Spanish Main, although a few of its more adventurous members have succeeded in crossing the Andes and establishing themselves as far south as northern Chile.

The text, of course, is highly technical, and will appeal chiefly to the specialist in this taxonomic group, but even those whose only interest in shells is esthetic will enjoy the illustrations. The reviewer feels most grateful for this book, upon which he expects to lean heavily in his own systematic work.

JOSHUA L. BAILY, JR.



AN ANNOTATED BIBLIOGRAPHY OF OYSTERS. *With Pertinent Material on Mussels and Other Shellfish and an Appendix on Pollution.*

By J. L. Baughman. *The Texas A & M Research Foundation, College Station.* 794 pp. Paper. 1948.

A comprehensive bibliography of oysters, a subject of prime scientific and economic importance, has long been needed. This work, compiled in a period of six months, will fill to some extent that need. The haste with which it has been assembled is responsible for many of its errors in detail, such as inadequate citation of illustrations, mistakes of pagination and title, etc., which mar the volume. Probably some of these mistakes are due to citation from secondary sources, but there are too many to permit the work to serve one of the important functions of a bibliography, which is the verification of incomplete references. A check of 25 titles of works dealing with oysters reveals at least 13 such errors. Some of them, along with the mangling of chemical formulae, can be explained because the printing was done by a small-town printing shop, unaccustomed to the precision necessary for such a task as this and unequipped for intricate printing.

The "annotations" consist of abstracts, summaries, and extended commentaries. Some short papers are reprinted entire, without any indication of that fact.

Abstracts are often taken directly from the *Anatomical Record*, *Chemical Abstracts*, or *Biological Abstracts*, with the abstracter's name retained; but anonymous quotations from abstract journals and summaries are not separated from the compiler's own comments. Since the greater part of the book's 794 pages consists of these annotations, many of them concerning rare or obscure papers, they comprise an original offering of some importance. It is unfortunate that the practice of publishing entire summaries, with original paragraph numbers omitted, is not generally indicated, and that more care was not given to checking transcriptions against the originals, for there are many places where the sense of a statement has been changed by an omission or garbled word. On p. 671 an abstract in French is hopelessly mangled. In many places the advance abstract of a paper, taken from the *Anatomical Record*, is published entire, together with the nearly identical abstract of the formal paper. This has added unnecessarily to the bulk of the text. Many important papers are cited without any abstract or comment whatever, and others receive such comments as "a very valuable paper," "a rather good general publication," etc.

Critical editing would have eliminated many peripheral references, such as those to general conchological treatises and faunal reports (Murphy's *Oceanic Birds of South America*, Ricketts and Calvin's *Between Pacific Tides*), and some of the newspaper articles, editorials, mimeographed circulars, and similar ephemeral items—which lend the work its claim to completeness at the expense of perhaps a fourth or fifth of the more valid literature concerning oysters and the physiology of shellfish.

Despite these faults—and the unacknowledged quotation and editing of summaries is a serious fault—this remains a very useful work, already proving to be of value to those in whose hands it has been placed. It is provided with subject and author indices. We cannot but marvel at the author's energy in assembling this mass of material. Nevertheless we must agree that to the author's own book (tu quoque!) applies his criticism of an equally amazing and fascinating compendium, Philpot's two thick volumes on *Oysters and All About Them*, which runs as follows: "A voluminous publication filled with repetitions, abstracts, and undigested results of inquiries of naturalists and government officials" (p. 480).

JOEL W. HEDGPETH



HANDBOOK OF MEDICALLY IMPORTANT MOLLUSKS OF THE ORIENT AND THE WESTERN PACIFIC. *Bulletin of the Museum of Comparative Zoology at Harvard College, Volume 100, Number 3.*

By R. Tucker Abbott. *Museum of Comparative*

Zoology at Harvard College, Cambridge. \$1.50 (paper). Pp. 243-328 + 5 plates; text ill. 1948.

Organisms may be of medical significance in three ways: they may be poisonous or parasitic in themselves; they may be harmless in themselves, but serve as intermediate hosts of other organisms which are poisonous or parasitic; or they may be a source of substances which have a beneficial use in medicine.

So far as I am aware, no mollusca fall into the third category mentioned above, although one of the Pilgrim Fathers has left us a recipe for "a metson to make a man's haire growe when he is balde," the chief ingredients of which are "bees and snayles." Man has always tended to fear that which he cannot understand, and it is perhaps not surprising that before the development of modern science such creatures as "snayles" were regarded with an awe akin to veneration. What a wonderful contribution to folk lore a history of quack medicine would be! But such a thought is a digression for which the reviewer begs the reader's pardon.

Medically significant mollusca are almost exclusively confined to the second of these categories. Many of the more common fluviatile mollusca harbor flukes or schistosomes that are deleterious to the health of the human species and domesticated animals. The importance of a knowledge of the life and habits of such mollusca is manifest at the present time, when so many citizens are returning home from war service in the Orient. Not only may some of these persons be infected with schistosomes to which certain of our native aquatic mollusca may be qualified to serve as intermediate hosts, but they might even inadvertently be the agent of introducing the exotic hosts or their eggs themselves.

The greater part of the highly technical work here reviewed is concerned with the Amnicolidae, a family of world-wide distribution. Many of its members do harbor schistosomes. There is also, however, a brief discussion of the Conidae, a family of marine gastropods whose bite is of considerable virulence. It is worth noting that while all the cones are provided with poison glands and ducts, in only a few species is the venom dangerous to man.

The author's object in compiling this work has been to meet an emergency by assembling all that is known regarding the part played by the mollusca in the dissemination of disease. The result is an interesting and significant contribution to the literature of preventive medicine.

JOSHUA L. BAILY, JR.



AN ANNOTATED CHECKLIST AND KEY TO THE AMPHIBIA OF MEXICO. *Smithsonian Institution, United States National Museum, Bulletin 194.*

By Hobart M. Smith and Edward H. Taylor. *United*

States Government Printing Office, Washington, D. C. 50 cents (paper). iv + 118 pp. 1948.

"Checklists" vary tremendously in potential usefulness. Some are bare lists of the forms that occur in a particular area; others are near-monographic treatments of the animals included. The Checklist under review is closer to the latter extreme and should therefore be highly valuable to those interested in Mexican amphibians. The arrangement of material need not be discussed here, since it is essentially like that of the same authors' *Annotated Checklist and Key to the Snakes of Mexico*, which was reviewed in these columns previously (Q.R.B. 21: 93. 1946). The seriation of the families of the Caudata (in order, the Sirenidae, Ambystomidae, Salamandridae, and Plethodontidae) differs from that of Bishop, Stejneger and Barbour, and Noble. The Salientia are also arranged differently from the system of Stejneger and Barbour. No reasons for these changes are offered. There are a number of other novelties: *Triturus* is split into *Taricha* and *Diemictylus*; and a new suborder, the Plethodontodea, is recognized.

Ninety-eight percent of the species included are monotypic (228 forms contained in 225 species). This condition is at variance with that in United States reptiles and amphibians, for which the proportions were 94 per cent in 1917 and 74 per cent in 1943 (Grobman and Tihen, *Amer. Nat.*, 78: 191-192. 1944). Either different systematic concepts have been applied or else much less is known of the Mexican fauna at the present time. From Smith and Taylor's Introduction it is clear that both causes are responsible. The number of forms per genus is 5.1, a figure not greatly different from that for United States reptiles and amphibians.

This report is certain to be extremely useful for those dealing with Mexican amphibians. Other checklist compilers might do well to include many of its fine features.

ARNOLD B. GROBMAN



BIRDS COLLECTED BY THE NATIONAL GEOGRAPHIC SOCIETY'S EXPEDITIONS TO NORTHERN BRAZIL AND SOUTHERN VENEZUELA. *Proceedings of the United States National Museum, Volume 97, Number 3219.*

By Herbert Friedmann. *Smithsonian Institution, United States National Museum, Washington, D. C.* Paper. Pp. 373-569 + 12 plates. 1948.

The collection of birds described in this report was made by Ernest G. Holt and his assistants on two expeditions, under the auspices of the National Geographic Society, in connection with the field work of the Venezuelan-Brazilian Boundary Commission. In the first expedition the party traveled the Orinoco from Ciudad Bolívar to the Casiquiare, down the latter to where it joins the Negro, and return. The second trip started on

the Amazon, went up the Negro and the Casiquiare, and then down the Orinoco to Ciudad Bolívar. The results of the study made on the approximately 3300 birds collected in this little known area of South America show that there is no marked distinction between the bird life of the Upper Amazon and the Rio Negro on the one hand and that of the Casiquiare and Upper Orinoco on the other. Of the 500 kinds of birds collected, only six show separate subspecific differentiation. Ten birds new to science were found, but have already been described elsewhere. In addition, the known ranges of some 30 birds have been extended: 11 birds are recorded as new to Venezuela and 5 as new to Brazil. The annotated list indicates the specimens collected and in many cases includes discussions of various taxonomic problems involved. Several plates of photographs taken on the expedition illustrate characteristic scenes and some of the bird life of the country traversed. An interesting novelty for such a strictly taxonomic and distributional paper of this sort is the inclusion of a common name for each of the forms discussed. For other information on the expeditions, the reader is referred to articles previously published in the National Geographic Magazine.

HENRI C. SEIBERT



HOW TO ATTRACT THE BIRDS. *Planting, Feeding, Housing.*

By Robert S. Lemmon, With Line Drawings by Roger T. Peterson, Tabea Hofmann and Henry B. Aul. The American Garden Guild and Doubleday & Company, Garden City, New York. \$1.50. 126 pp.; ill. 1947.

This handy little book provides most of the basic information needed to attract birds to the home. Several types of bird houses are described, and their construction is explained in rather complete detail. Favorite plants, both as sources of food and as nesting sites, are listed, together with the species of bird that is likely to be attracted. This vegetational list is divided into regional areas of the United States, thereby making the usefulness of the book national in scope. Bird baths, feeding shelves, and other accouterments for this pleasurable pastime are also described. Line drawings illustrate most of the material referred to in the text.

HENRI C. SEIBERT



CATALOGUE OF TYPE SPECIMENS OF MAMMALS IN CHICAGO NATURAL HISTORY MUSEUM. Fieldiana: Zoology, Volume 32, Number 4.

By Colin Campbell Sanborn. Chicago Natural History Museum, Chicago. \$1.00 (paper). Pp. 207-293; 1 plate. 1947.

The type, cotype, and lectotype mammals in the

Chicago Natural History Museum include 15 marsupials, 20 insectivores, 37 bats, 2 primates, 1 edentate, 8 lagomorphs, 185 rodents, 28 carnivores, 2 hyracoids, and 10 artiodactyls, 308 in all. It is hoped that the present list will clear up the considerable confusion surrounding D. G. Elliott's types. The taxonomic classification, reference to publication, synonymy, museum number, collection data, and description of condition are given for each specimen. There is also a list of the type specimens arranged by locality; and a complete index is provided.



ALASKA'S MAMMOTH BROWN BEARS.

By Will H. Chase. Burton Publishing Company, Kansas City, Missouri. \$2.50. 129 pp. + 16 plates; text ill. 1947.

The author of this book has long been familiar with the Alaskan brown bear, having spent much of his life in the area where they live. In this book he presents many field observations, organized in the form of the biography of an individual bear. This occupies a little more than half the book, the remainder being taken up with a series of hunting and similar anecdotes which have not been well edited and which leave an impression of disorganization with the reader. However, the book contains information that should be of interest to the hunter and amateur naturalist, and one cannot help but feel the sincerity of the author's interest in the conservation and study of these animals.

JOHN E. CUSHING



ZOO ANIMALS.

By E. G. Boulenger; Pictures by Maurice Wilson. Puffin Picture Books, Penguin Books, West Drayton, Middlesex. 1s. 6d. (paper). 32 pp.; ill. 1948.

This paper-bound volume of 31 pages deals with the limited group of mammals commonly found in our zoos. In order of presentation come primates, carnivores, ungulates, edentates, rodents, and marsupials. The straightforward, matter-of-fact descriptions of the appearance and habits of the animals are very well done, and the colored and pencil drawings accompanying the descriptions are excellent. *Zoo Animals* should do much to make a trip to the zoo more than just an outing for the younger generation.

C. P. SWANSON



LABORATORY MANUAL FOR INTRODUCTORY ZOOLOGY. Revised Edition.

By C. Courson Zeff. The Evangelical Press, Harrisburg, Pa.; Keeler's College Stores, State College, Pa. \$2.00 (paper). 154 pp.; ill. 1948.

The new edition of this laboratory manual (see QRB 20: 93. 1945) for a full year course in zoology, based on the study of animal types, has an additional exercise on the annelocoetes larva. The former key to the phyla has been replaced by L. Hyman's, and moved from the back to a place near the front of the book. Greek and Latin derivations for the scientific names are also now included in tables at the end of the manual.



ECONOMIC ZOOLOGY

HARNESSING THE EARTHWORM. *A practical inquiry into soil-building, soil-conditioning, and plant nutrition through the action of earthworms, with instructions for intensive propagation and use of Domesticated Earthworms in biological soil-building.*

By Thomas J. Barrett. Bruce Humphries, Boston. \$2.50. 184 pp. + 7 plates; text ill. 1947.

This is indeed a rare book, part poetry, part fact, and part muddleheadedness. As to the poetry, if an author wishes to rhapsodize about the excretions of animals, that, no doubt, is his privilege. *De gustibus non est disputandum.* A reviewer, however, must observe that the essential facts about what Thomas Barrett so quaintly calls the "night-soil" of earthworms could have been presented in a somewhat simpler and considerably more direct style.

The most useful part of the book consists of the detailed and elaborate directions, complete with scale drawings, for making various types of culture boxes for raising "the domesticated earthworm," evidently a strain of the brandling or manure pile worm, *Eisenia foetida*. In fact, the figure from Hofmeister of *E. foetida* shown on page 25 is redrawn on page 95 as the "Domesticated Earthworm." The only significant difference is that under the second picture the acknowledgment to Hofmeister is omitted.

The book may also serve as a challenge for "soil scientists" to produce valid tests of the double thesis proposed, namely, that earthworms are the chief factor in soil fertility, and that it is practicable deliberately to increase the fertility of the soil by increasing the earthworm population. Barrett believes his book provides a "definite affirmative" to both of these propositions. Why he should think so is difficult to understand. He himself quotes Lunt and Jacobson as saying, in a recent paper from the Connecticut Agricultural Experimental Station, that "conditions favorable to the worms, are at the same time favorable to plant growth." Despite a wealth of authors quoted, and extensive tables giving chemical analyses of worm castings compared with various soils, there is almost nothing here to show the real extent of the part played by earthworms in hastening decay and mixing soil. That it is considerable has been known since before Darwin, but to claim that the fertility of the Nile delta

is primarily due to earthworms is certainly an extravaganza.

As a clinching argument, Barrett points to the results obtained by one Christopher Gallup. This case is typical of the kind of evidence presented throughout the book. This Mr. Gallup increased his yield of corn from 80 to 196 bushels per acre in a period of over ten years. During that time he encouraged earthworms. He also manured heavily and regularly, harrowed in all weeds and litter at frequent intervals, and used selected seeds. He attributes his success "mainly" to the worms. With heavy understatement, Barrett concludes, "Maybe he has something." Maybe he has.

GAIRDNER MOMENT



A CATALOGUE OF INSECTICIDES AND FUNGICIDES. Volume I: Chemical Insecticides. Annales Cryptogamici et Phytopathologici, Volume VII.

Compiled by Donald E. H. Frear; foreword by F. F. Lininger. The Chronica Botanica Company, Waltham, Mass.; Stechert-Hafner, New York. \$6.50 (paper). xii + 204 pp. 1947.

As pointed out in the preface of this work, the search for new insecticides and fungicides has been a haphazard affair. The search has been lacking in continuity of effort. One method of systematizing the approach to the problem is to compile and assimilate all of the work done to date, with the hope that trends and relationships may be recognized. This work represents a compilation of the results of biological testing on a group of approximately 10,000 substances. The compounds are arranged by code numbers. Following the code number of each entry is the name of the compound, its formula, toxicity and concentration tested when known, the insects against which it is effective, and references to published papers or patents. The coding system is explained fully in the introduction. An alphabetical index of all compounds listed is to appear in Volume II. This is a valuable catalogue for research workers in the fields of entomology, plant pathology, and chemistry and will spare them the necessity of long and tedious literature researches.

V. G. DETHIER



OUR ENEMY THE TERMITE.

By Thomas Elliott Snyder. Comstock Publishing Company, Ithaca. \$3.50. xiv + 257 pp.; ill. 1948.

The title of this book implies a popular approach and discussion. The text, however, is largely technical, particularly in the earlier portions. While the paper is excellent and the typography above reproach, the half-tone illustrations leave a great deal to be desired. One could wish for more line drawings, like the one on p. 173, for such could with profit replace some of the

half-tones and the long detailed descriptions of building specifications. There are a number of irrelevant or inconsequential items. The organization of the material is rather poor. In short, the book seems to suffer from the lack of a competent and vigorous editor. Particularly in view of the title, it would seem very desirable to have in the early part of the book a clear, or even over-simplified description of the colonies and activities of the main groups of termites. Instead of giving so much space to various preventive treatments and methods of building to avoid termite damage or at least to reduce it, even to describing the various treatments used in different places for divers materials such as poles, lumber, and furniture, and the methods of preventing damage—it would be better to deal in general terms for all materials. An interesting point, made repeatedly, is that while termite damage in the United States is serious and may necessitate expensive repairs to timber structures, the damage is not likely to be of the catastrophic proportions which one might imagine from reading the advertisements and propaganda of certain firms which desire to obtain contracts from property owners for the control of the pests.

Like so many other books, this one is written primarily for the American reader. In some parts of the world, such as Siam, termites not only cause much damage but they are also of very definite advantage to the farmer, since the soils on the surface of the large termite mounds are relatively much more productive, when planted to garden and food crops, than the infertile soils of those localities on the whole.

ROBERT L. PENDLETON



HUNTING SMALL GAME.

By Bert Popowski. *The Macmillan Company, New York.* \$2.95. xiv + 225 pp. + 16 plates; text ill. 1948.

If you like to go hunting, this book will provide pointers on how, when, and where to shoot rabbits (cottontails, snowshoes, or jackrabbits), squirrels, woodchucks, and prairie dogs. Additional chapters give guidance for training rabbit hounds, recipes for preparing the game, and precautions to be taken against tularemia. Throughout the text there is considerable information on firearms and ammunition, explaining and describing types of loads, of shells, their velocities, trajectories, and performances to be expected. This information will be useful to many hunters who talk a lot but know very little about the mechanics and physics of their firearms.

The continual use of the word "varmint" for these game animals is objectionable. At times the reader feels that the writer is falling over backwards to demonstrate that he is a sportsman and not just a killer, and that true sportsmanship is the ideal for which each

hunter should strive. Here and there in the text, however, are suspicious circumstances that lead one to wonder whether the author follows his own precepts. Witness the time when the writer was on a *fishing trip* (italics mine) in Wyoming and ran into a colony of woodchucks: "The portly marmots were everywhere on the rock-studded hillside and we killed a half-dozen of them with no more weapon than the Colt handgun which we carried as anti-snake prevention." If statements such as this arouse no antagonistic feelings, then you will probably enjoy the book.

HENRI C. SEIBERT



BRIGHT WITH SILVER.

By Kathrene Pinkerton. *William Sloane Associates, New York.* \$3.75. iv + 347 pp.; ill. 1947.

This biography of the Fromm brothers is at times a rather exciting one. The story begins when the boys were young and possessed by an unquenchable desire to raise foxes. None of them had even seen a cross fox; their only acquaintance was with the common wild red fox of their Wisconsin wilderness home. But with stubborn ambition they set out to breed foxes, and this narrative recounts their tribulations, their progress, and their failures from the time of their humble beginning to their achievement in developing the largest silver fox fur farm in the world. The brothers decided to strive for bright silver pelts, in spite of the disfavor with which this variety was looked upon by the fashion world. With characteristic purpose they kept working toward their goal until it was finally recognized that the silver furs developed at the Fromm farms were undeniably superior to those preferred by current taste.

Along with fox farming the brothers raised ginseng, a root cherished in the Orient, in order to finance their fox-raising endeavors. Now they also possess the largest ginseng farm in the country. The battles against falling markets and other financial worries, the fights against distemper and encephalitis in the fox and root rot in the ginseng, make entertaining reading once the preliminary historical background of antecedents is passed. [Unfortunately, the copy at hand has some pages missing, skipping from p. 294 to p. 317, thereby preventing the reader from learning what Myrna Loy was doing at one of the biggest auction sales in the country.] Numerous illustrations depict the progressive development of the farm, its animals, the pens, the harvest, the fur sales, and the men responsible for this profitable enterprise. For the biologist, there are some data on fox life that are interesting; the veterinarian's battle against epidemics reads like a story from *Microbe Hunters*; the information on selection is too scattered for useful analysis. All in all, this book should be read for pastime only.

HENRI C. SEIBERT

BIRD DOGS.

By Ray P. Holland; illustrated by Fred McCaleb.
A. S. Barnes & Company, New York. \$5.00. xiv
+ 204 pp. + 36 plates; text ill. 1948.

As its title shows, this book describes and discusses the various breeds of bird dogs in use in the United States today. It includes, in addition, chapters on the training of dogs, field trials, the registry of dogs, how to buy dogs, and other pertinent items. The illustrations are numerous and good, and the author's style and ability are in keeping with his well-established reputation as a sports writer. The book should be received favorably by all who are interested in the subject.

JOHN E. CUSHING



RAISING LIVESTOCK.

By Walter H. Peters and George P. Deyoe. McGraw-Hill Book Company, New York and London. \$3.50.
x + 519 pp.; ill. 1946.

This is a modern book of wide and comprehensive plan that should be of great value to individuals interested in the practical solution of problems associated with the raising of livestock. The authors have in this one volume organized references and discussions of essentially all pertinent and up-to-date information on livestock raising, ranging from an introductory discussion of the nature of the business, through the selection of livestock and the handling and caring for it, to marketing and using the finished products. The material is clearly presented; and there is no doubt that the book will prove to be of great value to livestock raisers, whether novitiate or long experienced.

JOHN E. CUSHING



THE HORSE OF THE AMERICAS.

By Robert Moorman Denhardt. University of Oklahoma Press, Norman. \$5.00. xviii + 286 pp. + 20 plates; text ill. 1948.

This book presents, in an exceedingly satisfactory manner, an account of the horse in the Americas from the time of its introduction to the present, including discussions of various breeds and many pertinent points relating to horses and horsemanship. The author is obviously acquainted with a wealth of detailed information acquired through careful research, and without which he could not have written such a good book. While based upon detail, however, the material presented is not at all heavy, but is such as to clearly and neatly engage and hold the reader's interest throughout. Anyone, whether specifically horseman or not, who would like to learn more of the history and influence

of the horse in the New World will find this authoritative account excellent, both as to presentation and information.

JOHN E. CUSHING



THE HORSE OF THE DESERT

By William Robinson Brown, with an introduction by Major General James G. Harbord and Henry Fairfield Osborn. The Macmillan Company, New York. \$10.00. xxx + 218 pp. + 45 plates. 1947.

This book, originally published in 1929, has now been reprinted in a form that should make it more readily available to a wider audience. As noted by the publisher, it represents the only book devoted to the Arabian horse and has been written by an outstanding authority on this subject. The volume is well illustrated and includes a wealth of information about the Arabian origins of this breed as well as its position in the United States in 1929, particularly with reference to its superiority as a cavalry horse. The work would seem to be of most appeal to horsemen, rather than to the general reader.

JOHN E. CUSHING



INTRASEASONAL AND INTERSEASONAL VARIATIONS IN AVERAGE WEIGHT OF COLUMBIA RIVER CHINOOK SALMON (*ONCORHYNCHUS TSCAWYTSCHA*), 1939-1945. *Special Scientific Report Number 34.*

By Ralph P. Silliman, Willis H. Rich and Floyd G. Bryant. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. 33 pp. 1947.

RED TIDE. *Progress Report on the Investigations of the Cause of the Mortality of Fish Along the West Coast of Florida Conducted by the U. S. Fish and Wildlife Service and Cooperating Organizations. Special Scientific Report Number 46.*

By Paul S. Galtsoff. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. iv + 44 pp. + 9 plates. 1948.

DEVELOPMENT OF FISHERY STATISTICS IN THE NORTH ATLANTIC. *Special Scientific Report Number 47.*

By George A. Rounsefell. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. ii + 28 pp.; ill. 1948.

OUTLOOK FOR THE ALASKA HERRING FISHERY IN 1948. *Special Scientific Report Number 52.*

By L. N. Kolloen and C. H. Elling. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. 26 pp.; ill. 1948.

ANIMAL MORPHOLOGY

TEXTBOOK OF ANATOMY AND PHYSIOLOGY. *Second Edition.*

By Catherine Parker Anthony. *The C. V. Mosby Company, St. Louis.* \$3.75. 542 pp. + 5 plates. 1946.

This book grows out of the necessity to teach a course in anatomy and physiology to nurses. The author, who is a higher authority than the reviewer regarding what nurses should know, cannot be criticized for her choice of subject matter. Much thought has been devoted to classification and vocabulary. The reviewer, a physiologist, tends to classify the book as a very simple anatomical textbook; nevertheless, the functions of organs are described concisely and essentially correctly. There are mistakes of course, e.g., "If the craniosacral fibers (of the autonomic system) depress a *gland*, the thoracolumbar fibers stimulate it and vice versa." There is a tendency to deal with subjects (intelligence, unconsciousness, will, etc.) which most professional textbooks avoid; yet one must admit that these are important topics.

The series of questions and answers included with the book may be quite useful to many. But personally, the reviewer does not approve of such tests for advanced students, although others do. Among the answers, there are a few which are not correct or at least not known to be. For example: "Of the parts of any neurone which is the first to receive and transmit the nerve impulse? Axon, cell body, or dendrite." In the answer book, "dendrite" is given as correct, an answer that is debatable. I feel that the student should be permitted to debate.

On the whole this book represents a very creditable effort to meet the needs of a particular student group.

CHANDLER MCC. BROOKS



ANATOMY AND PHYSIOLOGY LABORATORY MANUAL AND STUDY GUIDE. *Third Edition.*

By Barry Griffith King and Helen Maria Roser; section on Endocrines rewritten by Erwin P. Vollmer; illustrations by M. Cartwright Baker. *W. B. Saunders Company, Philadelphia and London.* \$3.00. vi + 267 pp.; ill. 1948.

Although this is primarily a laboratory manual for nurses' courses in the subject, it is sufficiently broad in point of view and extensive in coverage to serve in general courses in human anatomy and physiology, too. The principal change from the second edition (see QRB 18: 289. 1943) is the complete revision of the unit on the endocrine glands, made by E. P. Vollmer. An *Instructor's Supplement*, containing lists of references and needed charts, models, histological

sections, preserved materials, fresh materials, and sources of supply is a helpful addition to the manual.

BENTLEY GLASS



ANATOMY, HISTOLOGY AND EMBRYOLOGY. *Fiat Review of German Science, 1939-1946.*

By Philipp Stöhr, Jr. *Office of Military Government for Germany, Field Information Agencies Technical.* Paper. xii + 148 pp. 1947.

This small booklet is an extremely condensed but useful introduction to a considerable literature in the related fields of anatomy, histology, and embryology, published in Germany during the war years, and which received little or no circulation outside of middle Europe. It is one of a series of similar publications, covering various branches of science and technology, issued by the Office of Military Government for Germany, under the joint supervision of the French, British, and American FIAT Agencies.

The information is presented in the form of abstracts or terse reviews (in the German language) of the contents of a number of the standard journals in the fields mentioned above, together with a few textbooks, handbooks, dissertations, etc. It was prepared by a staff of German scientists under editorial supervision. Guidance into the extensive literature covered is facilitated by detailed subclassifications within each field; and each major section is followed by its own bibliography.



A TEXTBOOK OF HISTOLOGY. *Eighth Edition.*

By Harvey Ernest Jordan. *D. Appleton-Century Company, New York and London.* \$7.50. xii + 690 pp.; ill. 1947.

This excellent textbook of histology has been quite extensively revised in its eighth edition. It is a pleasure to note that the section on Histologic Technic, which in former editions occupied 100 pages, has been eliminated. There are at present a number of textbooks devoted purely to histologic technical and staining procedures, a fact which renders such an addition to a book on histology quite unnecessary. A number of colored illustrations has been added. The page length has been increased and the volume as a whole diminished in size by a reduction in the number of pages from that in earlier editions.

From the viewpoint of a pathologist, one may gladly note adequate descriptions of the juxtaglomerular apparatus of the kidney, the glomi of the skin, and the cells of Berger in the testicular and ovarian hila. On the other hand, one finds that too little emphasis has been placed upon cells and structures which are of extreme importance pathologically. In view of the effectiveness with which alloxan destroys the β cells of the islets of the pancreas, there need be no hesitancy

in ascribing to these cells the function of insulin production, and this should be appropriately emphasized. The enterochromaffin cells are described under the small intestine, whereas it should be indicated that they occur in the stomach and large bowel as well. Under sweat glands, the apocrine variety should be clearly distinguished from the ordinary eccrine types, whereas in the text the former are not even mentioned. A clear statement of the cells chiefly concerned in hematopoiesis in the bone marrow of normal individuals would be of advantage. After reading the chapter on bone marrow, the student must be left with the impression that the hemocytoblasts are the only ones which divide and mature to produce cells which appear in the peripheral blood. It would help in rounding out the discussion of endochondral bone formation to illustrate the principles of remodelling of bone as it occurs particularly at the diaphysial ends of long bones. Graphic reconstructions of the normal thyroid gland would help the student to understand its gross and microscopic alterations in disease.

One would like to see some of the newer, expanding knowledge of histochemistry incorporated within the textbook. To compensate, the physiological discussions in the text could be shortened, made more precise and, in some instances, such as the adrenal cortex, brought up to date. These statements need not, however, detract from the excellency of this textbook for student and graduate purposes.

C. A. KRAKOWER



AN OUTLINE MANUAL FOR THE STUDY OF HISTOLOGY.
Revised Edition.

By Arthur J. Gatz. Burgess Publishing Company, Minneapolis. \$1.75 (paper). iii + 80 pp. 1947. This loose-leaf laboratory manual should be an excellent aid to the instructor in histology. It is basically a guide for the student so that he may obtain full information from the prepared set of slides. He is told what to look for and at the same time, by appropriate questions or statements, is given a complete and rounded picture of the structure and, to some extent, of the function of the tissue concerned. Untyped pages are interposed between the typed ones, permitting the student to draw what he sees under the microscope as well as to add his own notes.

C. A. KRAKOWER



CONGENITAL MALFORMATIONS OF THE HEART.

By Helen B. Taussig. The Commonwealth Fund, New York; Geoffrey Cumberlege, Oxford University Press, London. \$10.00. xxxvi + 618 pp. + 46 plates; text ill. 1947.

The literature on cardiac malformation is extensive, the contributions of Keith (1909), Spitzer (1923), and Abbott (1936) illustrating how the many variations of the condition have been analyzed by workers whose approach and interests have differed widely. The volume under consideration is a welcome addition to this literature, being the most complete and accessible presentation of congenital cardiac malformation yet to appear.

The primary aim of the book is to facilitate the differential diagnosis of malformations of the heart and great vessels in the living patient. To this end the clinical data are collated with autopsy findings. The classification of the cases is clinical, division being made into those of inadequate oxygenation (persistent cyanosis, with life expectancy of about 18 months) and those with a life expectancy of many years (clinical syndrome not distinctive during infancy). The first part of the book covers general principles and phenomena common to all congenital heart malformations. The last part deals with therapeutic measures. An appendix tabulates the salient features of the cases. The index is adequate. The relationship of abnormal morphology to circulatory pattern is excellently presented in a series of 46 full-page plates in color. The 177 text figures further clarify the presentation, particularly interesting among them being 14 diagrams which compare the normal fetal circulatory pattern with that present in certain of the malformations.

Although clinical in approach, interest in this book will not be limited to the practicing physician. The illustrative material makes available a wealth of specimens collected over many years. Helen Taussig's classification of her material, based on the clinical picture and terminal morphology, has resulted in the wide dispersal through the book of cases traceable to abnormal growth during a continuous embryological process, such as, for example, the partitioning of the truncus arteriosus. Reclassification on the basis of developmental background and determination of the age of the embryo at which the malformation first became established would highly benefit students of embryology.

The author writes clearly. Accuracy is neatly balanced with stylized generalization in diagrammatic material. The organization and presentation are products of a skilled teacher. As stated in the author's preface, the book was written from the writer's experiences rather than from analysis of the literature, and the bibliography is therefore incomplete. Although a volume of limited coverage, this book bears the mark of years of patient, careful work and is a tribute to the purposeful specialization of one of the outstanding clinicians of our time.

F. N. Low

THE NEOCORTEX OF MACACA MULATTA. *Illinois Monographs in the Medical Sciences, Volume V, Number 4.*

By Gerhardt Von Bonin and Percival Bailey. *The University of Illinois, Urbana.* \$3.00 (paper). xii + 163 pp.; ill. 1947.

This splendid study of the cellular architecture of the cerebral cortex of the rhesus macaque monkey furnishes those neuroanatomists and physiologists who study primates with a thorough and presumably very useful work. Its scope includes almost the entire cortex (except the allocortex), and its methods involve the study and analysis of sections of 20 μ in thickness, cut in various planes (horizontal, frontal, parasagittal, and oblique) and stained with thionin. A superb series of 62 photographs of selected sections reproduces for the reader the raw material on which the study was based. The author's conclusions regarding the distribution of the distinct cellular areas are graphically incorporated in a colored "brain-map" that serves as frontispiece. The text is given over chiefly to a discussion of the cell arrangements shown in the sections, but there is in addition a chapter on the gross fissural patterns of the cortex, and some data are given on the growth of the brain and its weight relative to body weight in the macaque.

The cream of originality of this type of study was of course realized by Brodmann and by Campbell more than forty years ago, and to the former in particular every subsequent worker has been enormously indebted. The present work in many ways supplements and also corrects that of Brodmann, which was done in 1905 on a different but closely related species of monkey. The close agreement of the present study with that of Brodmann, which was achieved with less material prepared by less adequate histological methods, is at once a signal tribute to Brodmann and an immeasurable relief to everyone else.

The matter of terminology in such a study as this, where the results are translated into a useful code or map, is both a difficult and an important one. The authors have chosen to use the symbols of Economo rather than the more widely used numerals of Brodmann. They have done so because the former scientist has published the most detailed description of the human cortex, and they felt that the present study would have greatest anthropomorphic value if the macaque brain were similarly labelled. Economo's terminology has a certain logic not possessed by Brodmann's. For example, Economo has labelled contiguous areas of the frontal lobe FA, FB, FC, FD, whereas Brodmann's equivalent numbers are 4, 6, 32, 9. In addition, if one wishes to recognize two distinct strips within area FA, they may be tagged FA α and FA β . Thus the system is more flexible than Brodmann's, where the only recourse is to add another number that will of necessity be serially separated from the previous one. On the

other hand, the terminology of Economo becomes cumbersome if piled too high, and it is difficult to use orally, in such designations for areas as FCBm and FCop. In any case Brodmann's numerals have become ingrained in the literature to an extent where the other system, regardless of its value, will be resisted by the majority of workers in the field.

The value of this work will rest upon its usefulness over a period of years, and any present judgment would be premature. It bears the marks, however, of an exceptionally capable piece of work.

JAMES M. SPRAGUE



HUMAN NEUROANATOMY. *Second Edition.*

By Oliver S. Strong and Adolph Elwyn. *The Williams & Wilkins Company, Baltimore.* \$6.00. x + 442 pp.; ill. 1948.

Among the numerous new textbooks of neuroanatomy which have appeared during the past ten years this is perhaps the finest. It is comprehensive and is written clearly, in a manner which should be readily understandable to the college student who is making his his first acquaintance with the subject.

A series of eight more or less introductory chapters are presented before the detailed anatomy of the central nervous system is considered. Each of these supplies a useful background for the interpretation of more complex features to follow. The chapter on development is accurately written but is overloaded with a highly technical terminology, the interpretation of which must be difficult for those unfamiliar with the subject.

In this edition a new chapter on segmental and peripheral innervation has been added. It briefly recapitulates the gross anatomy of the peripheral nerves and their relation to dermatomic and myotomic areas, along with a brief description of the syndromes associated with the chief peripheral nerves. Terminating this chapter is an all too brief discussion of the regeneration of injured peripheral nerves. This section could well be expanded. In recent years reviews have appeared in various journals covering the principles of nervous regeneration and the potentialities and limitations of subsequent functional reintegration, but there is no adequate presentation of this important phase of practical neurology in a place readily accessible to the interested medical student. The chapter on the blood supply of the brain has been enlarged with the addition of useful color plates. This chapter is now as complete a presentation of the subject as can be found in any textbook on neuroanatomy.

To repeat: for its coverage of the field of neuroanatomy this textbook is recommended as one of the finest. It should be especially helpful to the medical student.

F. N. Low

TEXTBOOK OF THE NERVOUS SYSTEM. *A Foundation for Clinical Neurology.*

By H. Chandler Elliott, with an Introduction by Wilder Penfield. J. B. Lippincott Company, Philadelphia, London, and Montreal. \$8.00. xiv + 384 pp.; ill. 1947.

This book is one more of the growing number of elementary textbooks on the anatomy of the nervous system. It should be asked, in view of the present abundance of them already, whether the present volume offers anything new or whether it fills an important gap. It seems to do neither. It is essentially a presentation of neuroanatomy that the author has found useful in his teaching at the University of South Carolina, and which he believes will make a difficult subject more logical and interesting for the average student.

The author does write well, and he has included a sizable list of the experimental literature. The text is both alive and integrated. In contrast, the illustrations are very unsatisfactory. They consist of a series of simplified, stripped-down diagrams that the author refers to as the "basic brain," and of a small number of photographs. In the former, Elliott follows almost all writers on the nervous system in attempting to show the complexities of fiber tracts, connections, and nuclei by means of diagrammatic sketches. These, however, are simplified to a point where they frequently bear little or no resemblance to a real brain, and in addition they are poorly executed. The student will have difficulty in relating the "basic brain" to the actual material which he will see. The photographs are too few in number to help in his orientation, and many of them are taken of poor material and are not well reproduced.

JAMES M. SPRAGUE



FUNDAMENTALS OF NEUROLOGY.

By Ernest Gardner. W. B. Saunders Company, Philadelphia and London. \$4.75. xii + 336 pp.; ill. 1947.

This is an integrated, well written, and eminently useful book. It aims at and achieves an enviable measure of simplicity, yet its title is not misleading, and in contrast to most so-called elementary texts it does not present a static picture. For a great difference exists between the presentation of "fundamentals" and of what is merely a simple story, and in the latter lies the pitfall of most writers who attempt to measure nature in teaspoons. Usually such efforts serve only to compress a broadly ramifying, vastly incomplete yet vastly challenging field into an absurd little pill that can be swallowed without chewing.

The author begins with several chapters on the gross and more obvious characters of the nervous system, and has added to the inevitable yet useful diagrams which

adorn the teaching of neuroanatomy, a number of photographs of the material itself—nerves, spinal cord, and brain. A discussion of embryological development is followed by a chapter on the microscopic anatomy of the nervous system, again with photographs where possible. The remainder of the book presents the histology of the spinal cord, brain stem, cerebellum, and cerebrum from a functional point of view, based on experimental and, whenever possible, on clinical evidence also. Such a point of view is exemplified by the chapters on Excitation and Conduction, General Properties of the Reflex Arc, Structures Mediating Reception and Response, and the Control of Muscular Activity. In the discussions of the various divisions of the nervous system, the cerebral cortex is given more space and attention than any other part. General references to the literature are included in each chapter, and there is a glossary at the end of the book. The beginning medical student, as well as the general biologist who is unlearned in neurology, will find this little book interesting and very useful.

JAMES M. SPRAGUE



ANIMAL X-RAYS. *A Skeleton Key to Comparative Anatomy.*

By Brenda Putnam. G. P. Putnam's Sons, New York. \$3.50. 96 pp.; ill. 1947.

This is a book about bones, the bones of vertebrate animals and the many variations of the central vertebrate scheme. Initiating the various joints for identification, the author carries the young reader through the vertebrate groups, showing how the variations in bone length, joint structure, and general flexibility all have their meaning in terms of adaptability, movement, posture, etc. The book, with excellent illustrations accompanied by a readable text, should give the young zoologist a keener insight and greater knowledge of the various animal forms and the evolutionary adaptations which fit animals for the lives they live. The book should likewise be of much value to those with artistic aspirations, for a knowledge of bone structure and movement is basic to any portrayal of outward form.

C. P. SWANSON



ANIMAL GROWTH AND DEVELOPMENT

LE FORZE CREATRICI DELL'UOVO. *Questioni Moderne d'Embriologia. Sapienza, Volume III.*

By Pasquale Pasquini. Vallerini, Pisa and Rome. L. 700 (paper). 333 pp. + 8 plates; text ill. 1948.

This little book is an eloquent and encouraging sign of the times. Addressed to the *colto pubblico* of Italy, it is a carefully non-technical exposition of the field of experimental embryology as it had developed before

the war. One is very happy to know that general interest in this field in Italy justified such a publication.

Pasquini has chosen classical themes for his chapters: a historical introduction; gametogenesis; normal embryogenesis, using the sea-urchin and amphibian eggs as models; germinal localization; organizing centers and induction in the amphibian egg; other aspects of embryonic induction; fields and gradients. In each chapter he has selected important material to present fully and clearly, accurately documented, and with excellent illustrations. The style is flowing, uncluttered by detail, yet extremely concrete. The reader is given a good deal of factual material in extremely palatable form. References to personalities add to the interest of the story as it is unfolded.

Readers on this side of the Atlantic might wish that the author had seen fit to include more details regarding the important work now under way in various Italian laboratories; but they must recall that the purpose of the book is to present the classical material of the subject to the layman, and not to advertise new directions for the scientific worker. Pasquini and the editors of the series *Sapienza* are to be congratulated on their enterprise and on the manner in which it has been fulfilled.

DOROTHEA RUDNICK



ANIMAL PHYSIOLOGY

COMPARATIVE PHYSIOLOGY.

By Bradley T. Scheer. John Wiley and Sons, New York; Chapman and Hall, London. \$6.00. x + 563 pp.; ill. 1948.

During the past ten years the attention of physiologists has turned with ever increasing frequency toward the invertebrates. With this growing interest in the so-called "lower animals" there has come a realization that the examination and comparison of the different groups from a functional point of view may elucidate many of the basic problems of general physiology. As the study of the physiology of invertebrates has come of age, the need for a textbook suited for aspiring students of that field has grown. The appearance of the present volume is indeed timely. Scheer has attempted to fill this manifest need by writing a book which attempts to illustrate "by excerpts from the recent literature of comparative physiology the state of our knowledge in certain fields and, more important, the potentialities of the comparative method." In addition, the book was planned to be suitable as textbook for an advanced university course in comparative physiology.

After an introductory chapter which presents a summary of the physiological processes common to all animals, the author adopts a phylogenetic approach

to his subject. Thus, with the exception of arthropods and vertebrates, discussion of which occupies four chapters, each major phylum is dealt with in a separate chapter. Within each chapter the topics are arranged on a functional basis. Hence, although the book as a whole is based on a phylogenetic plan, one may, by comparing the same function in each chapter, gain some idea of physiological changes and adaptations throughout the animal kingdom. In order to facilitate this, the author has arranged his discussion of functional units similarly in each chapter. In the section on the Annelida, for example, the order of treatment is: feeding, digestion, circulation, respiration, metabolism, excretion, osmoregulation, neuromuscular system, locomotion, central nervous system, sense organs, behavior, and summary.

There is, admittedly, a diversity of opinion as to whether any comparative subject in biology can be taught better by using a phylogenetic or a functional approach. Scheer has preferred the former, but in so doing he appears to have defeated one of the chief purposes of his book, in that the burden of comparison now rests largely on the shoulders of the reader. While one may consult, for example, the topic Vision in the chapter on the Mollusca and then again in the section on the vertebrates, he will find that points of functional similarity and dissimilarity have not been clearly and concisely stated. The comparisons of one phylum with another are not so well done as the comparisons of one vertebrate type with another within such a group.

Faced with the problem of choosing appropriate material from a vast array of facts, the author has done commendably, although one is frequently disappointed with the superficiality with which certain subjects have been treated. The material consulted has indeed been "organized into a series of sketches on the physiology of each of the major animal phyla," but most certainly these cannot be construed as representing the present state of our knowledge. One is piqued by such phrases as the following: "Extensive consideration of sense organs always involves much anatomical detail and has consequently been avoided in this book." It is true, nevertheless, that the faults are chiefly those of omission rather than commission, so that, as an introduction to the field of comparative physiology, this book should serve a useful purpose. It is well documented and indexed.

V. G. DETHIER



ANIMAL COLOUR CHANGES AND THEIR NEUROHUMOURS: A Survey of Investigations 1910-1943.

By George Howard Parker. Cambridge, at the University Press; Macmillan Company, New York. \$6.50. x + 377 pp.; ill. 1948.

In this relatively small volume, G. H. Parker has brought together a tremendous number of data bearing on the phenomenon of color changes in cephalopods, crustaceans, and cold-blooded vertebrates. During the thirty-year period, 1910 to 1943, with which the present survey is primarily concerned, many important investigations were made in an effort to determine the mechanisms involved in bringing about the rearrangement of pigment within characteristic, highly specialized, color-bearing cells designated as chromatophores. It is to be expected that the physiological mechanism responsible for this spectacular and often rapid alteration in integumentary coloration is by no means simple, involving, as it does, reflex activities induced through the sense of sight, humoral substances, and, in some cases, the direct action of light on the skin.

In his discussion of the various concepts formulated in his field of research, Parker points out that the distinction which has frequently been made in the literature between nervous and humoral activation of chromatophores seems to be disappearing. In recent years it has become evident that the terminals of chromatic nerve-fibers excite their end-organs, the chromatophores, in much the same way that many other effector nerve-fibers appear to excite their responding organs, namely, through minute amounts of secreted substances (neurohumors) which are passed from the terminal to the effector. Hence, between the nerve ending and the chromatophore there appears to be the same relation as, for example, between the adrenal gland and the chromatophore, in that a substance produced by one activates the other. The one point of difference is that in the case of the nerve terminal the source is very near the color-cell, whereas in the case of the gland (adrenal) the source is far away from this cell. This difference of nearness or remoteness is not, in the author's opinion, in any real sense important, since in both instances a specific secreted substance, a neurohumor, is liberated, and upon reaching the chromatophore excites a response. It is readily seen that such a view is in strong contrast with the older conception of nervous stimulation by a nerve current.

Parker defines a neurohumor as a hormone produced by any type of nerve-cell (receptor or neurone) or by a gland controlled by neurones, and effective as an activator or inhibitor for other nerve-cells or for effectors. Included under the term "neurohumors" one finds a considerable number of substances such as adrenaline, intermedine, acetylcholine, sympathine, other products from chromatophoral nerve terminals, and the activating substance in the extract from the eye stalks or other secretory centers in crustaceans. Whether or not neurohumors will be found to have such a wide application as the above definition implies remains to be ascertained. It should, however, be said that the concept of neural humorism has contributed much to our understanding of the physiology of the chromato-

phores and has further brought the subject into line with the modern idea that chemical agents serve to transmit excitation at synapses and at the junctions of nerve endings with other types of effectors. The physiology of chromatophores is still an "invitingly open" field.

One of the most valuable features of this book is the extensive bibliography of over 1200 literature references. These are conveniently listed under three heads: (A) Surveys—including publications which present a general survey of the structure and functions of chromatophores; (B) Publications chiefly historical (prior to 1910); and (C) Publications from 1910 to 1943, inclusive. The text is fairly well illustrated.

M. RAWLES



MANUAL FOR LABORATORY WORK IN MAMMALIAN PHYSIOLOGY.

By Fred E. D'Amour and Frank R. Blood. *The University of Chicago Press, Chicago.* \$2.75 (paper). 176 pp.; ill. 1948.

This is an unusual book, especially for days like these. It is a work-book about the laboratory rat as subject for a wide variety of physiological experiments. It should be of interest and great value to all laboratories engaged in physiological work. Colleges, medical schools, pharmaceutical houses, and all other research laboratories where such procedures are employed should know what this book has to offer. At a time when the cost and care of larger laboratory animals is prohibitively expensive, it offers a practical solution to the question of how to do good work using the laboratory rat. Not the least valuable of its contributions are the descriptions and pictures of apparatus to be used.

The list of experiments is most complete. Procedures for raising, handling, weighing, injecting, numbering, and anesthetizing rats are given, along with operative procedures for cannulation of the trachea, carotid artery, and jugular vein. There are six experiments on blood, ranging from blood volume to measurement of the freezing point of blood; twelve experiments on the heart and circulation, including studies of blood pressure, blood flow determinations, circulation times, carotid sinus experiments, and observations on minute vessels; six experiments on respiration, including studies of respiratory rate, tidal air and minute volume measurements, Hering Breuer reflexes, and O₂ consumption, R. Q. and BMR determinations. Experiments on digestion and metabolism include ones on glucose absorption, alloxan diabetes, gastric secretion, and intestinal motility. Excretion experiments on saline diuresis and bladder contraction time are given. There are seven experiments on the nervous system, including ones on nerve-muscle relations, energy of muscular

contraction, the Bell-Magendie Law, motor areas in the cerebral cortex, and the autonomic nervous system. There are seven experiments on various aspects of endocrine activity (adrenalectomy and cortin; thyroidectomy and thyroxin; pregnancy tests; ovariectomy and estrogens; gonadotrophic hormones and castration and testosterone). An experiment on antibody formation ends the list.

There can be no doubt that modifications of many of the ingenious and detailed procedures described here will be made as workers with other experience and facilities use them. But this book provides proof that a wide range of instructive experiments can be done simply and on inexpensive animals, without the necessity for large animal quarters, and with the employment of standard or easily improvised equipment.

S. R. M. REYNOLDS



LABORATORY MANUAL FOR EXPERIMENTAL PHYSIOLOGY.
(Fifth Edition.)

By H. D. Bergman and E. A. Hewitt. Burgess Publishing Company, Minneapolis. \$1.75 (paper). iii + 116 pp. 1946.

This is another manual which is probably admirably suited to meet the educational requirements and responsibilities of its authors. It is intended to serve as a reference as well as a laboratory guide and notebook. The course begins with a consideration of blood and ends with the Special Senses. It contains some physical chemistry, nutrition, and general physiology, besides the commoner physiological experiments carried out with mammals and amphibian tissues. The manual seems to show that much effort has been spent on its production. It indicates a thorough and sound course of teaching. This book may satisfy one's curiosity as to how teaching is done elsewhere. Laboratory manuals can seldom meet the needs of other institutions, but a teacher will welcome the opportunity to glean new ideas and devices for effective teaching.

CHANDLER McC. BROOKS



LABORATORY EXPERIMENTS IN PHYSIOLOGY. Fourth Edition.

By W. D. Zoethout. The C. V. Mosby Company, St. Louis. \$3.00. 263 pp.; ill. 1948.

This laboratory guide does not attempt to usurp the function of textbooks by publishing long detailed explanations and sample charts and graphs of obtainable results. The exercises given deal precisely with the apparatus needed and the experimental procedures to be followed. The book is divided into two parts. Part I contains eleven chapters and some 152 laboratory

exercises. The subjects covered in these chapters are: apparatus, general physiology, muscle physiology of nerve, central nervous system, circulation, respiration, sense organs, the alimentary canal, and urine and sweat secretion. Part II deals with the rudiments of physiological chemistry and contains 100 exercises covering the chemistry of carbohydrates, fats, proteins, digestion, urine, and various body substances and food materials. The exercises are very short and simple. For beginning students of college or university level they would be quite suitable, but many are too elementary for graduate students. The book contains no experiments on metabolism. Many of the short exercises could, it seems, be combined into more inclusive single experiments. One does not obtain a very good grasp of the interrelationships and the function of the body as a whole from such a series of superficial contacts. This little book will serve as a very valuable aid to many who teach introductory courses in physiology.

CHANDLER McC. BROOKS



A LABORATORY MANUAL OF GENERAL PHYSIOLOGY.
Revised Edition.

By Nelle A. Hartwig. Burgess Publishing Company, Minneapolis. \$1.50 (paper). ii + 69 pp. 1947.

This manual was designed for use in an elementary course in physiology for students of pharmacy, but it is thought by the author that it might be used in similar courses for students of home economics, nursing, and the arts and sciences. It is intended for a 2-quarter course of 4 credit hours each. The manual is divided into fifteen major sections, each of which is subdivided into exercises. The titles of the subdivisions suggest a rather peculiar concept of the subject matter of general physiology. The exercises propose some very simple experimental procedures, and then many questions are asked. Many of the suggested activities seem to have very little connection with physiology, but it is quite possible that the manual meets the need for which it was intended. Certainly not much previous training is expected of the student.

CHANDLER McC. BROOKS



THE PHYSIOLOGY OF DOMESTIC ANIMALS. Sixth Edition.

By H. H. Dukes; with a chapter on *The Physicochemical Basis of Physiological Phenomena* by E. A. Hewitt; and a part on *The Endocrine Organs, Reproduction, and Growth* by S. A. Asdell. Comstock Publishing Company, Ithaca, New York. \$7.00. xiv + 817 pp.; ill. 1947.

This is an enlarged and revised edition of a standard textbook, now firmly established for teaching physi-

ology in schools of veterinary medicine and animal husbandry. Its pattern remains the same. It deals systematically and comprehensively with the subject in an elementary style. It is replete with useful data of a comparative nature, especially with respect to digestion and absorption, heat regulation, and reproduction. As such, it is a useful reference for students of medicine who have much to gain by adopting a comparative point of view.

The basic fault of the treatment of the subject used in this book, as judged by one trained in physiology applied to medicine, is that it consistently fails to put in relief those comparative functions in the body which are peculiarly suited to the requirements of different domestic animals. For example, the relationship between muscle mass and working power defined by the Rev. Samuel Haughton (*Principles of Animal Mechanics*, 1873) must apply with special force to various domestic animals. Similarly, the cardiovascular, respiratory reserve, and other factors that make a winning race horse different from a slower steed offer tantalizing problems to the physiologist. It is clear from the account of heat-loss mechanisms here that much remains to be learned concerning these in different types of animals. The section by Asdell on Reproduction is accurate and well done, in a basic sense. One gains the impression, however, that the comparative mechanisms are not sufficiently treated for students of animal husbandry. Particularly disappointing, in view of the basic work of Grosser, to which Mossman has added his now classic contribution, is the statement that a placental classification of mammals is difficult to make.

S. R. M. REYNOLDS



HUMAN PHYSIOLOGY. *Third Edition.*

By F. R. Winton and L. E. Bayliss. *The Blakiston Company, Philadelphia and Toronto.* \$7.00. xvi + 592 pp. + 1 plate; text ill. 1948.

The authors of this volume have performed a most useful service. They have prepared an integrated text which is short yet very complete and comprehensive in many aspects of physiology. It should fulfill a needed role for all who require or desire a coherent picture of the whole subject. The authors write that "medical students are expected to learn too much and think too little, and the authors have therefore prevented the book from growing out of its shape as one of the smaller textbooks of Human Physiology." It is, one may add, one of the best.

In the preparation of this book, the authors have secured the assistance of many of the leading active English physiologists, each writing on his own specialty. In order to prevent the text from being unbalanced, however, Winton and Bayliss have exercised judicious editorial supervision with respect to content and em-

phasis. The contributors, with their contributions, include Pickering (circulation), Mackay (respiration), Gregory (digestion), Smyth (Sheffield), Young (carbohydrate metabolism and endocrine glands), Newton (reproduction and endocrine glands), Eggleton (muscle chemistry), Whitteridge (nerve, special reflex system, localizations in the central nervous system), Feldberg (autonomic system and chemical transmission), Lythgoe (eye), and Rawden-Smith (ear). The authors are themselves responsible for the other sections, which deal with blood and other body fluids, excretion, and muscle physiology, as well as other parts scattered throughout the text. The first chapter is entitled *Physiological Activity*. It orients the reader with respect to the range of coordinated bodily activities involved in muscular exercise, physiological equilibria, and fatigue.

In any textbook of physiology, particularly a collaborative effort which maintains relative brevity, it is inevitable that there will be some aspects of the subject that are inadequately treated. A different reviewer would note different things. To this one it seemed that the parts relating to peripheral circulation have an inadequate discussion of the reciprocal and coordinated control of different peripheral vascular beds, the effect of branching, and so forth. Similarly, the discussion of seasonal variation in the functioning of the minute vessels and their adjustments with age, topography, and posture would render a traditional treatment of the subject enlightening. As much may be said for certain other sections of the book. For example, one will not grasp from this textbook an appreciation of those mechanisms whereby the uterus becomes adapted to the growing products of conception during pregnancy. But to insist upon and extend such criticisms would detract from the success which Winton and Bayliss have actually achieved in preparing a comprehensive text that is also brief. To supplement his reading a medical student or teacher can doubtless resort to one of the larger standard textbooks for reference purposes.

S. R. M. REYNOLDS



HUMAN PHYSIOLOGY SYLLABUS.

By J. A. Dye. *Comstock Publishing Company, Ithaca.* \$3.00 (paper). iv + 152 pp.; ill. 1947.

It seems that there is very little to be said about such a work. Unquestionably, the subject matter of physiology is rather thoroughly dealt with here and the syllabus probably meets the aims of the author's course quite admirably. This one begins with a consideration of Blood, Circulation, Respiration, etc., and ends with Nerve, Muscle, and the Central Nervous System. Many courses in physiology begin with a consideration of nerve and muscle, but the reviewer's only conviction about that is that a teacher should be

permitted to begin as and where he pleases. The mixture of information and promise given in the syllabus betokens a high ambition. The syllabus so closely approaches a textbook in size, however, that one rather wonders why the author didn't just amplify things a bit more and call it that. In places it is a bit too condensed, and one is left wondering about classification—why should talking and singing be classified as protective respiratory reflexes? All in all, this is a very impressive syllabus and should serve to inform others of the subject matter of the Physiology Course at Ithaca.

CHANDLER McC. BROOKS



HUMAN PHYSIOLOGY.

By Kenneth Walker. Penguin Books, West Drayton, Middlesex. 1s. 6d. (paper). 169 pp. + 2 plates; text ill. 1948.

This is a brief, pocket-sized edition of a popularized version of the subject of human physiology. The author is a London consulting surgeon and the author of physiological and medical treatises. The book is written for the purpose of allaying fears on the part of laymen—since anxiety is, according to the author, the commonest symptom seen in the consulting room. The essential core of human physiology is covered quickly and well. The book is not critical, and it is not always accurate and up to date. That is of little consequence, however, to those who are most likely to read this booklet and benefit by it. After all, it is a pocket-sized edition to be purchased for the equivalent of a quarter dollar in the numerous book shops that serve such a large proportion of the English reading public.

S. R. M. REYNOLDS



THE 1947 YEAR BOOK OF ENDOCRINOLOGY, METABOLISM AND NUTRITION.

Edited by Willard O. Thompson and Tom D. Spies. The Year Book Publishers, Chicago. \$3.75. 575 pp.; ill. 1948.

Annual volumes in many scientific fields have become a necessity owing to the inability of even the most assiduous student of technical literature to read everything that is published which has a bearing on his specialty. The present volume is the second under the title. It will be welcomed by progressive physicians, investigators, and all technically trained people in every field of science who wish to follow the progress of research in biochemistry.

Even the studious specialist profits by reflection on

well prepared comments on those scientific papers which outstanding investigators select as the most significant contributions of the year. In the present volume, 293 pages are devoted to approximately as many individual papers relating to studies of the pituitary, thyroid, parathyroids, adrenals, testes and ovaries. Metabolism and nutrition reviews are given 261 pages. These cover pancreas and liver, alimentary tract, hemopoietic system, cardiovascular system, the brain and nervous system, genito-urinary system, dermal, muscular, and skeletal systems, malnutrition, and therapy.

An important feature of this book is the brief editorial comment which follows, in most cases, the abstract of the original contribution. These add to the value of the volume.

E. V. McCOLLUM



RECENT PROGRESS IN HORMONE RESEARCH. *The Proceedings of the Laurentian Hormone Conference. Volume II.*

Edited by Gregory Pincus; Committee on Arrangements: R. W. Bates, R. D. H. Heard, and G. Pincus. Academic Press, New York. \$8.00. vi + 427 pp.; ill. 1948.

The articles in this volume differ somewhat from the usual review in that the subject matter was first given orally, that the authors are particularly concerned with their own current work, and that original material comes out in the text and in the very readable discussions that follow most of the presentations. As in the first symposium, range of interest is wide. Fourteen articles, grouped into five sections, cover physical methods in hormone research, pituitary control and activity, hormone metabolism, hormonal regulation of metabolism, and aspects of clinical endocrinology. Fresh viewpoints are particularly notable in the contribution of Petersen on lactation in the larger animals, and in Anderson and Long's beautiful perfusion experiments with the pancreas. Richter discusses the toxic thioureas, originally developed as rodenticides, with an entertaining aside on how to catch (and keep) a wild rat.

The topicality of a conference seems to demand early publication—even at the expense of a format as handsome as this one. It may be pointed out that, as this meeting was held in September, 1946, we are at the present date still two conferences behind. A further complaint—against the tendency to duplicate reviews in related publications—and one not negligible, in view of the insidiously rising cost of such publications—is addressed to no one in particular.

H. R. CATCHPOLE

PSYCHO-PHYSIOLOGIE DES GLANDES ENDOCRINES ET DU SYSTÈME NEURO-VÉGÉTATIF. *Nouveau Traité de Psychologie, Tome Septième, Livre II.*

By P. Caridroit. Presses Universitaires de France, Paris. 100 fr. (paper). iv + 112 pp.; ill. 1946.

Ignoring the quotation of references now superseded (or discredited), this will be found an interesting, brief account of the psychical manifestations associated with the endocrines, both normally and in dysfunction. That of the autonomic system appears to be largely a verbal exercise ranging around the various possible "tonuses" that may be imagined. The author's conclusions are conservative and point to the fact that we know next to nothing of the processes affected by the hormones, either in their target organs or in their wider relationships with the central nervous system.

H. R. CATCHPOLE



THE SIGNIFICANCE OF THE EXTRACELLULAR FLUID IN CLINICAL MEDICINE. *The Ernest A. Sommer Memorial Lectures Delivered at the University of Oregon Medical School, June 6, 7 and 8, 1946.*

By L. H. Newburgh. J. W. Edwards, Ann Arbor. \$1.75 (paper). 64 pp.; ill. 1946.

This is one of a series of lectures designed to emphasize the advances in physiology and pathology as a basis for improving the practice of medicine. The purpose of this particular lecture was to discuss the relations between abnormalities of extracellular fluid and a number of diseases. The various fluid reservoirs of the body are described, and the composition of these body fluids is given. Very brief accounts of the respiratory and renal regulation of extracellular fluid pH and composition are also given. Following this description of the nature of the extracellular fluid and the normal regulatory mechanisms, the clinical significance of studies of this fluid is elucidated. The abnormalities of the extracellular fluid in a variety of pathological states are described, together with the effects of a reduction of body sodium, and a study of edema, dehydration, water balance, and the control of the specific gravity of urine. Water requirements in nephritis are given, and certain low sodium diets are listed. This is a very instructive book, and also one easily read. The author is to be congratulated on the clarity of this presentation.

CHANDLER McC. BROOKS



CHEMICAL ANATOMY, PHYSIOLOGY AND PATHOLOGY OF EXTRACELLULAR FLUID. *A Lecture Syllabus. Fifth Edition.*

By James L. Gamble. Harvard University Press, Cambridge. (paper). 160 pp.; ill. 1947.

The fifth edition of this highly valuable lecture syllabus (see QRB 20: 178. 1945) includes five additional charts, raising the total to 52. It is scarcely necessary to say that the text has been brought up to date.



PHYSIOLOGY OF MUSCULAR ACTIVITY. *Third Edition.*

By Edward C. Schneider and Peter V. Karpovich. W. B. Saunders Company, Philadelphia and London. \$3.75. viii + 346 pp.; ill. 1948.

This edition marks a turning point in the life of this well-known book. A new author appears beside Professor Schneider and new work makes it a worthy successor to the earlier editions. While the entire text has been rewritten, much new material is included in the chapter on Work, Energy and Mechanical Efficiency; and sections on Body Types and Posture have been added, along with chapters on Activities for Convalescents and Ergogenic Aids. All of these reflect the interests of the junior author.

The approach to each phase of the subject is from the basic approach of fundamental physiology, leading over into its special applications with respect to exercise, physical fitness, and physical education. Admittedly, for those who desire a full, accurate, and comprehensive understanding of the relevant physiology, other sources and authors must be consulted. There are, moreover, some noteworthy omissions of matters one would expect to find discussed in a textbook on this subject. There is no adequate description of the role of anaerobic metabolism in energy production by the body, nor does one find any reference to the brilliant work of Szent-Györgyi and his associates on the probable roles of actin and myosin in muscular contraction. Similarly, in discussing the role of gaseous interchange in exercise, one finds no reference to the enzyme carbonic anhydrase.

The sanity of the approach which these authors take to the subject of fatigue and physical fitness is refreshing. The sentence which reads, "The purpose of physical education is not to win games for one's alma mater, but to help each person to attain an optimum level of development predetermined by his structural potentialities," is reminiscent of the wartime attitude of Karpovich who, when drawing up physical training programs for flying personnel in the AAF, said that flyers had to fly airplanes—not carry them.

S. R. M. REYNOLDS



MUSCULAR CONTRACTION. *Annals of The New York Academy of Sciences, Volume XLVII, Article 6.*

By Alexander Sandow, R. S. Bear, Ernst Fischer, A.

S. Gilson, Jr., Eugene Guth, C. E. Hall, M. A. Jakus, S. W. Kuffler, Otto Meyerhof, Severo Ochoa, Robert W. Ramsey, F. O. Schmitt, G. M. Schoeffle, Shih-Chang Shen, H. Burr Steinbach, and S. M. Walker. *The New York Academy of Sciences, New York.* \$3.00 (paper). Pp. 665-930 + 9 plates; text ill. 1947.

This publication is a series of papers read at a Conference on Muscular Contraction held by the Sections of Biology, and Physics and Chemistry of the New York Academy of Sciences, February 15 and 16, 1946. It is a notable publication for a number of reasons. It presents a perspective of the subject which crosses the border zones between several disciplines, and it offers variety and considerable depth within the different disciplines.

The publication is divided logically into four parts: I, Dynamics; II, Ultrastructure; III, Chemistry; IV, Mechanic Chemical Coupling. Alexander Sandow deserves great credit for his organization and planning of the Conference which resulted in this publication. The individual authors present their subjects with great care and thoroughness, and some achieve a simplicity of statement and forceful logic which render them distinctive as contributions to a symposium that will be read by physiologists generally. Among these are articles by Ramsey (Dynamics of Single Muscle Fibers), Schmitt, Bear, Hall and Jakus (Electron Microscope and X-ray Diffraction Studies of Muscle Structure), Meyerhof (The Main Chemical Phases of the Recovery of Muscle), and Shen (The Interaction of Myosin and Adenosine Triphosphate). Others deal most competently in a highly technical way with their subjects, and only two are of a standard not equal to the rest, inasmuch as they consist of reports of numerous data and facts without an interpretation of them into a broad or general concept of muscular contraction.

The recent important work of Szent-Györgyi on actomyosin was not generally known to American workers at the time this symposium was held. There are a number of references to preliminary notes by Szent-Györgyi, and Shen presents many aspects of this work. It is probable, however, that many viewpoints contained in the book under review would have been modified or simplified had the full import of Szent-Györgyi's Continuum Theory (see, *Chemistry of Muscular Contraction*, reviewed QRB 23: 75; and *The Nature of Life*, both by Szent-Györgyi, 1948) been considered from many angles by the contributors to this symposium.

S. R. M. REYNOLDS



MUSCLE TESTING: *Techniques of Manual Examination.*
By Lucille Daniels, Marian Williams, and Catherine

Worthingham. *Designed and illustrated by Harold Black.* W. B. Saunders Company, Philadelphia and London. \$2.50 (paper). 189 pp. 1946.

This booklet describes manual muscle tests and the test positions for evaluating muscle strength. It is well illustrated with line drawings. Along with the description of the tests, the authors have outlined "range of motion," "factors limiting motion," "fixation," and have given the origin, insertion, and action of the prime mover in the group-action test. All of this information is pertinent to the subject of muscle testing. The material is presented in a concise manner, and is especially suitable for quick reference. The diagrams are very clear, and in most instances accurately illustrate the test as presented. In various instances, however, either text or diagram or both are technically faulty.

The anatomical action of a muscle and the test movement will not be identical unless the position of the body is such that the muscle will be called on to function. The test (p. 69) in which the tensor fascia femoris is supposed to be the prime mover is in reality a test in which the posterior gluteus medius and minimus are prime movers. By internally rotating the leg in the direct side-lying position, the tensor is rotated out of position to lift against gravity. If the pelvis were rolled backward (to a position midway between back and side-lying) or the patient were back-lying, then the tensor would be brought into strong action to maintain internal rotation, abduction, and flexion, which are the anatomical actions of this muscle.

The illustration of the range of motion in the hip internal rotation test (p. 60) leads one to assume that the range of motion which one has in the sitting position is present in the back-lying position with the knee bent over the end of the table, and the lumbar spine flat on the table. Such is not the case unless the hip is more relaxed than normal. In an average individual, internal rotation of the hip is practically locked past the perpendicular position of the lower leg in the supine position described above.

The middle trapezius is named as prime mover in the scapular adduction test (p. 110). With no attachment along the vertebral border of the scapula, but only along the spine, it is quite misleading to represent the middle trapezius as prime mover in the straight adduction motion, as illustrated by the "range of motion" drawing. Actually, the inferior angle rotates outward as the middle trapezius adducts the upper part of the scapula.

In the scapular adduction and depression test (p. 114) the muscle drawing and the test movement are accurately described, but the scapula does not move in the direction illustrated by the "range of motion" drawing.

In the trunk flexion test (p. 27) two of the illustra-

tions show the hip flexor action in the abdominal muscle test by the fact that the lumbar spine and sacrum are shown lifted from the table in flexion of the pelvis on the thighs. The verbal description under "range of motion" is accurate, but the drawing does not follow the description accurately. Tests of group action as described in this manual must therefore not be considered as accurate tests for the prime mover named in every instance. This booklet will be found useful by those who choose to test muscles according to group action for the purpose of functional evaluation of strength, but is of little value for those who seek to do individual muscle testing for the purpose of neuromuscular diagnosis.

HENRY O. KENDALL



THE INTEGRATIVE ACTION OF THE NERVOUS SYSTEM.

By Charles Sherrington. Yale University Press, New Haven. \$6.00. xxvi + 433 pp. + 1 plate; text ill. [1906]; 1947.

Thanks to the Physiological Society, biologists may now own a copy of Sherrington's classic of 1906, out of print for a generation. The text has been reset and reprinted in its entirety, and unchanged except for the correction of misprints and minor errors. All figures were redrawn, since the old blocks were worn out. A signed photograph of the author, a curriculum vitae, and a bibliography have been added to enhance the edition, and, best of all, Sherrington has himself written a new Foreword for it. These twelve pages are an apologia in reply to the criticism that Sherrington's concern in this volume almost wholly with reflex behavior led him to ignore the higher levels of psychological integration. Sherrington replies that the choice of reflex action for study was for practical laboratory reasons, for the very reason, in fact, that it is free of the complications of the psyche, with its "urges" and "drives," and free even of such complexities as occur in autochthonous, rhythmic activities like breathing. Sherrington goes on to discuss briefly the great problem of the integration of the two incommensurables, body and mind, the physical and the psychical. Sherrington ventures no final answer, of course, any more than the humblest physiologist—but his hinted preference for a dualistic solution is worthy of note.



DOSAGE BIOLOGIQUE ET CONTRÔLE DES MÉDICAMENTS. Bibliothèque Scientifique Belge, Section Biologique.

By Jean La Barre and Jacques Thomas. Masson et Cie., Paris. 220 fr. (paper). 142 pp.; ill. 1947. This 140-page monograph deals with the biological

standardization of the more important pharmaceutical and biological preparations. The author discusses those instances where biological tests are accepted as superior to chemical determinations. Bioassay is used for the determination and standardization of potency and also of toxicity and tolerance. Among the latter toxicity tests for arsenicals are given in detail. The author then describes the customary procedures for the bioassay of endocrine preparations (thyroid, suprarenal, posterior pituitary, insulin, and male and female sex hormones), for the most important vitamins, and also for digitalis, ergot, and anthelmintics, with European and American standard procedures with special reference to the Belgian Pharmacopoeia. Many of the methods are given in sufficient detail that the reader could perform them without having to consult further reference works.

GERTRUDE D. MAENGWYN-DAVIES



THE SALICYLATES. A Critical Bibliographic Review. Monographs of the Institute for the Study of Analgesic and Sedative Drugs. II.

By Martin Gross and Leon A. Greenberg; with an Introduction by Howard W. Haggard. Hillhouse Press, New Haven. \$6.00. xviii + 380 pp.; ill. 1948.

The extensive use of the class of medicinal agents known as salicylates has given rise to a vast scientific literature. The authors of this volume have reviewed the pertinent literature in all languages and have prepared a bibliography of over 4000 titles. This review is the second in a series on analgesic and sedative drugs. The first volume which appeared in 1946 was a monograph on acetanilid. The work on the salicylates deals with a group of chemically and pharmacologically related compounds. The use of derivatives of salicylic acid in the treatment of rheumatic fever and as analgesics in medical practice is well established. In proprietary pharmaceutical preparations the salicylates are consumed in tremendous quantities, chiefly as acetylsalicylic acid. The authors state that the average production in the United States in the period 1935 to 1944 was more than six million pounds of acetylsalicylic acid per year. These compounds are thus of considerable toxicological interest. The literature on both the pharmacology and toxicology of the salicylates has been reviewed in detail.

The seven chapters of the book cover the following subjects: therapeutic uses; salicylate poisoning in the United States, with case reports and the question of addiction or habituation; historical background—the discovery of the medicinal properties of the salicylates; the fate of the salicylates in the body, a review of

analytical methods that will be useful to workers in this field. Throughout the text the results of published work are presented in tabular and chart form.

It is unfortunate that the four structural formulas given for the salicylate compounds on p. 8 are incorrect. The tremendous alphabetical bibliography would have been rendered more legible and more usable had the columns been indented so as to make authors' names stand out. These are minor points and detract but little from the general excellence of the volume.

C. JELLEFF CARR



TRAVAUX RÉCENTS SUR LES TOXIQUES DE GUERRE: LE BAL (*British Anti-Lewisite*). *Actualités Biochimiques*, Number 8.

By Z. M. Bacq. *Éditions Desoer, Liège; Masson & Cie., Paris*. 60 fr. (paper). 48 pp.; ill. 1947.

This small booklet contains a collection and abstraction of work on poison gases, giving data found by American and British authors, and bringing up to date our knowledge of the biochemical and pharmacological experimentation in this field that was undertaken by Belgian workers during and after the war.

The studies on British Anti-Lewisite are most fully described. The tables and figures in this pamphlet clearly illustrate the pharmacologic action of the vesicants which attack the SH-groups of proteins. Peacetime medical applications are reported and references given. The booklet contains an excellent bibliography of 60 references. It should be highly interesting to American readers. It is well written, clear, and informative.

GERTRUDE D. MAENGWYN-DAVIES



L'INTOXICATION PAR L'ALCOOL ÉTHYLIQUE. *Pharmacologie, Toxicologie et Médecine Légale. Médecine et Biologie*, Number 2.

By H. Casier and A. L. Delaunois, with preface by C. Heymans; edited by Marcel Florkin. *Éditions Desoer, Liège; Masson & Cie., Paris*. 100 fr. (paper). 185 pp. + 1 chart; text ill. 1947.

This is a scientific report on the pharmacology and toxicology of ethyl alcohol, with charts, statistics, and an extensive bibliography. It is quite evident that the authors are concerned about alcohol and intoxication, considering it of national importance (in Belgium also), because of the very direct bearing it has on motor vehicle and other avoidable serious accidents. There is, therefore, some emphasis on tests for alcohol concentration in the blood, serological analyses being evaluated as both useful and necessary in medical legal cases.

Chapter X surveys thoroughly the effects of other pharmacologic substances (hypnotics, narcotics, analgesics, vitamins, insulin, etc.) on ethyl alcohol after ingestion; and there is also an able, though brief, discussion of the factors of individual variation in alcohol tolerance, such as fatigue, mood, and so forth.

The toxic quality of alcohol itself—aside from nutritional depletion, varying avitaminotic and psychological conditions—is unequivocally stressed by the well-supported scientific conclusion that “while the presence of 1 g. ‰ alcohol in the blood constitutes a real danger in motor vehicle driving (autos, buses, trains), even slight amounts of alcohol cause potential hazard changes in the physical and nervous motor system coordination.”

VICTORIA CRANFORD



ANIMAL NUTRITION

A TEXTBOOK OF DIETETICS. *Second Edition*.

By L. S. P. Davidson and Ian A. Anderson, with Diet Sheets constructed by Mary E. Thomson and a Foreword by Sir John Boyd Orr. Paul B. Hoeber, Medical Book Department of Harper and Brothers, New York and London. \$6.00. xx + 517 pp.; ill. [No date].

This book is directed primarily to students of medicine and general practitioners. The authors express the belief that the family doctor, properly instructed, can and should play the chief part in the education of the public on matters of diet and nutrition. The authors are professor of medicine and lecturer on clinical chemistry, respectively, at the University of Edinburgh and the University of Aberdeen. This reviewer does not share the opinion of the authors that the family doctor can or should be an educator in nutrition for the general public.

The book is well written and is a reliable source of information about many aspects of food and nutrition. Twenty chapters include: a general survey; the physiology of nutrition; diet in periods of physiological stress; nutrition and diet in war-time; dietetic treatment for diabetes mellitus, diseases of the alimentary tract, the liver and biliary tract, the kidney and urinary tract, gout and rheumatism, obesity and excessive leanness, the cardiovascular system, infectious diseases, and the anemias; and special feeding methods. Part V includes tables of food analyses, and for construction of individual and group diets, recipes, tables, and thirty-eight diet sheets relating to various normal and pathological conditions. A novel feature of the book is the inclusion after the discussion of each vitamin of a list of proprietary vitamin preparations with their declared potencies. Most of these have trade names common in England but not familiar to Americans.

E. V. McCOLLUM

THE CHEMICAL COMPOSITION OF FOODS. *Second Revised Edition.*

By R. A. McCance and E. M. Widdowson. *Chemical Publishing Company, Brooklyn, New York.* \$3.75. iv + 156 pp. 1947.

This revised edition of tables of the chemical composition of foods comes from the Department of Medicine of the University of Cambridge. The correction of mistakes in the former edition has been made with care. Wherever published values showed wide discrepancies, new analyses have been undertaken. "Every calculation and figure has been checked by at least two persons."

The classification of foods, of a practical rather than scientific character, is into the following groups: cereals and cereal foods; dairy products; meat, poultry, and game; fish; fruit; nuts; vegetables; sugar, preserves, and sweetmeats; beverages; beers; condiments; vegetable fats; cakes and pastries; puddings; meat and fish dishes; egg and cheese dishes; sauces and soups; vegetable dishes. There are two sets of tables, giving the composition per 100 g. and per oz., respectively. Many, if not most, of the foods are found in the American diet, so that the tables should find great use by all who need a reference work on the composition of common foods.

BENTLEY GLASS



FOODS: *Their Values and Management.*

By Henry C. Sherman. *Columbia University Press, New York.* \$3.25. x + 221 pp. 1946.

This book is essentially a companion to *The Science of Nutrition*, being planned to supplement the latter with a popular account of food values and the best ways to coordinate the economic and nutritional phases of food management. The foods are grouped into ten food-groups: grain crops; mature legumes and nuts; potatoes and sweet potatoes; green and yellow vegetables; citrus fruits and tomatoes; other fruits and vegetables; milk and its products (except butter); meats, fish, poultry, eggs; food fats; sugar and sweets. Following an introductory chapter on food supply in the modern world, there is a chapter on each one of these food groups. The place of each food group in the individual, family, and national dietary is compared with its contribution to energy, protein, mineral, and vitamin needs. The distribution and conservation of vitamin values and the amino acid balance receive special consideration. While the book seems to be written primarily for housewife, dietitian, and home economics student, biologists who are interested in problems of nutrition will find it useful. The bibliography includes more than 500 titles, and there is a good index.

BENTLEY GLASS

DIET AND PERSONALITY.

By L. Jean Bogert. *Garden City Publishing Company, Garden City, New York.* \$2.00. x + 181 pp. [1934]; 1947.

It is a relief to a harried reviewer to run across so good a writer as Jean Bogert. Her topic is the relation of nutrition to constitutional types. She writes in a breezy but competent way of all sorts of nutritional problems, from susceptibility to infections to indigestion and constipation. She is no faddist. There are signs that the book has been revised and brought up to date, although this edition passes as a reprint rather than a new edition. For a book fourteen years old (see QRB 9: 485. 1934), *Diet and Personality* is surprisingly fresh and worth-while.



NUTRITIONAL DISORDERS OF THE NERVOUS SYSTEM.

By John D. Spillane, with a foreword by George Riddoch. *The Williams & Wilkins Company, Baltimore.* \$5.00. xvi + 280 pp. + 32 plates; text ill. 1947.

The author was Lieutenant-Colonel in the British Army during World War II and had a broad experience in prison camps. While serving in the army as Advisor in Neurology, Middle East Command, he investigated among German and Italian prisoners of war and Polish refugees a number of those syndromes which later were found also to have affected a considerable number of captives of various nationalities in Japanese prisons.

The book covers, rather briefly, our present knowledge of all known nutritional diseases attributable to deficiency of one or more of the water-soluble vitamins. The difficulties of etiological assessment in terms of vitamins, qualitative and quantitative food deficiencies, and accumulation of toxic metabolites are discussed. The thirteen chapters are devoted to: The Vitamin B Complex; Pellagra; Beriberi; Polyneuritis; Wernicke's Encephalopathy; Nicotinic Acid Deficiency; Encephalopathy and Allied States; Subacute Combined Degeneration of the Spinal Cord; Nutritional Neuropathy in Warm Climates; Nutritional Neuropathy in War-time; the author's personal experiences (two chapters); Gastrointestinal Tract and Nutritional Neuropathy; and General Conclusions. A well selected bibliography of the more important scientific papers on which the chapters are based is appended to each chapter. Clinicians concerned with nervous disorders and mental diseases, physiologists, and students of nutrition will find much of interest in this volume.

E. V. MCCOLLUM



THE BIOLOGICAL STANDARDISATION OF THE VITAMINS. *Second Edition.*

By Katharine H. Coward. *The Williams & Wilkins Company, Baltimore.* \$5.00. viii + 224 pp. + 7 plates; text ill. 1947.

This scholarly volume by the head of the nutrition department of the Pharmaceutical Society of Great Britain will be deemed indispensable by scientists in every country who are concerned with the standardisation of vitamins. Katherine Coward is a notable authority in the department of biochemistry which she represents. Thorough competence is reflected throughout the book.

The volume treats in Part I of: the general principles which govern the biological methods of determination of the vitamins; animals suitable for the determination of vitamins by biological methods; the determination of vitamins A, B₁, C, D, and E; the interdependence of the vitamins. Part II consists of four chapters: the standard deviation; factors influencing the accuracy of vitamin determinations; the limits of error of a determination of a vitamin; the improvement of biological assays. The appearance in 1947 of Vol. XII of Biological Symposia, *Estimation of the Vitamins*, an exhaustive discussion of this subject by specialists of high standing in America, does not render unnecessary the study of Coward's book.

E. V. McCOLLUM



BIOPHYSICS

ELEMENTARY MEDICAL PHYSICS.

By Howard O. Stearns. *The Macmillan Company, New York.* \$4.75. xiv + 354 pp.; ill. 1947.

The author has made a determined effort to point out to the student where and how the laws and theories of physics are applied in the biological sciences, and in the equipment and operation of a hospital. The topics covered are those of an introductory course in physics, viz., mechanics, heat, electricity, magnetism, x-rays, atomic phenomena, and light. The book is written in the style of an elementary textbook, with paragraph headings and many illustrations. Study questions and problems are included at the end of each chapter. The book should be very useful for pre-medical students, nurses, and physio-therapeutists, etc. A useful appendix and bibliography are included.

TITUS C. EVANS



X-RAY DIFFRACTION STUDIES IN BIOLOGY AND MEDICINE.

By Mona Spiegel-Adolf and George C. Henny. *Grune*

& Stratton, New York. \$5.50. viii + 215 pp.; ill. 1947.

This is apparently the first comprehensive survey on x-ray diffraction for biology and medicine in the English language. X-rays are diffracted or reflected from planes of atoms and produce patterns on the recording film which are unlike those produced by light or by the electron microscope. The diffraction pattern makes it possible to calculate the spacing and arrangement of well-ordered atoms in the specimen. A diffraction pattern may show whether a material is crystalline or amorphous, whether there is distortion or strain, whether it is pure or a mixture of two or more substances, and so on. There are many possibilities for the application of the x-ray diffraction method to studies of biological materials, including fluids and blood, growing soft and bony tissues, filterable viruses, and many other substances. Other advantages, as pointed out in the introduction, are that only very small amounts of material are required, that the study does not alter the specimen for other analysis, and that x-ray diffraction studies can be carried out with colloids, deeply colored materials, and poorly soluble materials, since the method does not depend upon the use of true solutions.

The topics, which are discussed in satisfactory detail, are as follows: theory; apparatus and techniques; interpretation; x-ray diffraction studies of carbohydrates, amino acids, proteins, nucleoproteins, muscle, lipids, nerves, steroids, bones, teeth, and concretions.

TITUS C. EVANS



X-RAYS IN PRACTICE.

By Wayne T. Sproull. *McGraw-Hill Book Company, New York and London.* \$6.00. viii + 615 pp. 1946.

This book may be used as a textbook for students interested in x-rays and their applications. It will serve also as a reference book because of its index, bibliographical footnotes, and tables in the appendix.

The book begins with a short history of x-rays, a short chapter on x-ray tubes, and a very good discussion of the continuous x-ray spectrum or the so-called "white" radiation. These chapters are followed by one on characteristic x-rays, and by two on the interaction of x-rays and matter. A discussion of x-ray generating equipment is succeeded by a chapter on the rudiments of radioactivity. Several chapters then follow which will be of especial interest to the radiologist and radiobiologist, discussing the topics of the measurement of radiation, protection, radiography, and radiotherapy. The last half of the book deals primarily with industrial radiography and x-ray diffraction studies.

TITUS C. EVANS

THE BIOLOGIC FUNDAMENTALS OF RADIATION THERAPY.

By Friedrich Ellinger, with a preface by Maurice Lenz. Elsevier Publishing Company, New York. \$5.00. xvi + 360 pp.; ill. 1941.

The author has here compiled, in textbook form, some results and problems of radiation biology that are of importance in the practice of radiation therapy. The book deals with the effects of roentgen, gamma, alpha, beta, neutron, ultraviolet, and visible radiation on various tissues and organs of the human body. There are many topics, and these are treated in summary rather than in detail. The result is a very good book for introductory reading for radiologists and for biologists who are interested in the biologic effects of radiations. The original edition was in German and the literature cited is predominantly European. Together with the references given in Duggar's *Biological Effects of Radiation* (McGraw-Hill, 1936) this provides the biologist with a good list of such references up to 1936. An enormous amount of work in this field has been done since that date, but an investigator will do well to read Ellinger's book before attempting to read all of the more recent reports.

TITUS C. EVANS



LES BASES PHYSIQUES ET BIOLOGIQUES DE LA ROENTGENTHÉRAPIE.

By Paul Lamarque with the collaboration of Pierre Bétoulières, Jean Reboul, Edmond Debains, and Pierre Lorimy; preface by André Strohl. Masson et Cie., Paris. 300 fr. (paper). xii + 530 pp.; ill. 1942.

This book by Paul Lamarque and his collaborators is a comprehensive text designed primarily for the training of radiologists, but it will also be of value to the biologist who is interested in the effects of x-rays. It begins with chapters on the nature and properties of x-rays, continues with a discussion of the physical and chemical effects of x-rays, a description of apparatus related to x-rays, and concludes with biological aspects. The biologic portion considers x-ray effects on the cell; the modification of radiosensitivity; quantitative considerations; the so-called wave-length factor; the action of x-rays on tissues, tumors, and inflammations; biologic dosimeters; techniques of radiation therapy; radiation damage and protection problems; and in the final chapter, theories of biologic effects of x-rays. The bibliography includes 651 references, some of which are as recent as 1940.

TITUS C. EVANS



AN INTRODUCTION TO COLOR

By Ralph M. Evans. John Wiley & Sons, New York;

Chapman & Hall, London. \$6.00. x + 340 pp. + 15 plates; text ill. 1948.

The trouble with the study of color is that it does not fall exclusively within any of the major scientific domains. Color is a problem for the physicist, because the stimulus to color must be specified ultimately in terms of the distribution of radiant energy in it. It is also a major concern of the physiologist because the exact nature of the receptive cells, photochemical reactions, and neural connections which mediate color vision are still incompletely understood. And, finally, it falls properly within the psychologist's purview because color is a subjective experience; it depends on a conscious being and is influenced by his attitude, mood, and set. In one respect, this is an unfortunate state of affairs in that the physicist, physiologist, and psychologist very often do not understand each other, even though they may be working on closely allied problems.

Evans has filled at last a long-standing need for a unifying text on the science of color. His book starts with the nature of the physical stimulus, proceeds next to the physiology of vision and the psychophysics of color vision, and then shows how the mind influences the subjective experience of color. The book ends with some chapters on illuminants, paints and pigments, color in photography, color in art, and design and abstraction. Since Evans is a physicist, it is natural to expect that his discussion of psychological problems might perhaps be inadequate. Puristic psychologists will undoubtedly object to the way he speaks of the mind, for example, as though it were an entity. However, these lapses seem of minor importance. The author has done a masterly job of coordinating some extremely difficult material from diverse fields.

Pedagogically speaking, the book is a model. Evans begins as though the reader had never seen a graph, yet before he is through the reader has been led through some extremely difficult concepts in physics and sensory psychology—color temperature, ICI diagrams, and perceptual constancy, just to name a few. The book requires no mathematical background beyond high school algebra, and it is possible for Evans to do the job he has done only through an extensive use of clear illustrations and drawings (there are 304 in the book).

The publishers are especially to be complimented on the format of the book. The type is clear, the layout attractive, and the illustrations are reproduced beautifully. Especially noteworthy are the 15 full-page color plates, each of which illustrates a point much better than any verbal description could possibly do. All in all, this is a book which students of the science of color, whether they be experts or beginners, will enjoy reading and will want to own.

A. CHAPANIS

BIOCHEMISTRY

GENERAL CHEMISTRY. *An Introduction to Descriptive Chemistry and Modern Chemical Theory.*

By Linus Pauling; Illustrations by Roger Hayward. W. H. Freeman and Company. \$4.25 (textbook ed.); \$5.00 (trade ed.) viii + 595 pp.; ill. 1947.

Linus Pauling has an enviable reputation as an expositor of modern chemical theory. Now his clear and incisive style has been employed in creating an outstanding elementary textbook of general chemistry. This book is definitely not just another textbook among the multitude available. The author has been at some pains to organize his material in accordance with modern concepts and to insure a straightforward development of the subject.

The first ten chapters lead the student (assumed to have had no previous instruction in chemistry) through a clear and logical discussion of the nature and properties of matter, stoichiometry, relations between the chemical elements, valence and chemical bonding, and oxidation-reduction reactions. The first chapters of a detailed descriptive nature then appear, dealing with chromium, manganese and related metals, and with the halogens. The following 23 chapters deal with descriptive chemistry and theoretical subjects (electrolysis, reaction rates, gases, solutions, equilibrium, acids and bases, etc.) in a well-organized sequence. The chapters on theoretical subjects are presented in sufficient detail to provide a solid basis for students majoring in chemistry. It is inevitable that in a book which covers so wide a range of material many sections appear somewhat abbreviated. However, there is no portion of the book which does not serve as an admirable point of departure for the instructor planning his lectures.

The text is profusely illustrated in a most attractive manner, and many numerical examples to illustrate general principles are worked out. Beginning with Chapter Two, all chapters are accompanied by well-prepared sets of problems. The format and print are generally excellent. Some of the figures appear to have suffered in reproduction, at least in the copy examined.

There is little doubt that the general dissemination and use of this book will exert a salutary influence on instruction in beginning chemistry courses.

MARTIN D. KAMEN



LE PH ET SA MESURE. *Les Potentiels d'Oxydo-Réduction le rH. Bibliothèque Scientifique Belge; Section Biologique. Fourth Edition.*

By M. Huybrechts. Masson et Cie., Paris. 400 fr. (paper). 474 pp.; ill. 1947.

It would appear that this text is intended as a basis of

instruction in the elements of the subject rather than as a guide to precise measurements, for it is deficient in useful tables, important references, and details of technique. Nor has it an index. Undoubtedly this book will serve its purpose well among those who prefer the French language, but American readers will be disappointed in the discussions of theoretical principles, several of which have not been modernized.

W. MANSFIELD CLARK



MECHANISMS OF REACTIONS AT CARBON-CARBON DOUBLE BONDS. *Lectures on Progress in Chemistry.*

By Charles C. Price. Interscience Publishers, New York. \$2.50. viii + 120 pp. 1946.

It is rare to find a book such as this in which so much is contained in so little space. In 120 pages the author has managed to cover in a clear and concise manner the reactions of olefinic compounds, bringing to bear the best substantiated evidence available on the mechanisms of the reactions discussed. A well integrated treatment of vinyl polymerization reactions is a special feature.

In an overcondensed first chapter, a brief review of resonance and mesomerism introduces a discussion of the author's own contribution—an attempt to explain satisfactorily orientation in aromatic nuclei by using only electrostatic interactions based on the available data for bond angles and atomic radii. It would have aided the presentation of this material considerably, as far as clarity is concerned, if the author could have been induced to expand this section appreciably beyond the confines of a lecture. Some readers who will applaud the author's courage in expressing dissatisfaction with resonance concepts (p. 8) will balk at his rather indiscriminate lumping (p. 9) of "hyperconjugation" (essentially a concept involving molecular orbitals) with resonance (usually based on an atomic orbital approach). This is, however, a minor criticism. The author has done much to help the reader by including sample calculations of polarizing force for various substituent groups. However, it will be necessary for the reader to supplement this discussion by reading some original references. Had the latter material been included in this book, it would have aided greatly in getting the reader through some of the difficulties occasioned by the terseness of the text.

To me it seems that the approximations in the calculations have somewhat optimistically been minimized. There is also difficulty in understanding why the change in electron distribution is assumed to occur in such a way that both para and ortho positions have a high (or low) electron density relative to the meta position when an electron-repelling or electron-attracting sub-

stituent approaches the ring carbons. Despite these uncertainties it must be admitted that Price makes out a good case for his proposal. All chemists who desire to remain abreast of modern developments in organic chemistry should own this book.

MARTIN D. KAMEN



PREPARATION AND MEASUREMENT OF ISOTOPIC TRACERS. *A Symposium Prepared for The Isotope Research Group.*

By D. Wright Wilson, A. O. C. Nier, and Stanley P. Reimann. J. W. Edwards, Ann Arbor. \$1.80 (paper). viii + 108 pp.; ill. 1947.

This paper-bound booklet consists of a series of eight succinct articles on various practical aspects of isotope application, written by outstanding workers in the field. Each article is accompanied by a selected bibliography. Because of its practical nature, its brevity, and its authoritative authorship, this little book has been of great value to a large number of investigators who have been using isotopes in their work. Although now two years old, it is still of great value for the above reasons. One of its features is its emphasis upon the value of stable isotopes as tools in biological research. In this connection, everyone using stable isotopes should read Rittenberg's article on mass spectrographic analysis, because of the illuminating explanations which the article gives.

Books on the use of isotopes in the biological field have appeared in numbers in the past few years. Much of their emphasis is on radioactive tracer methods. Among those which will be found helpful in amplifying the briefer treatment of radioactive tracers given in the Edwards lithoprint, and which have already been reviewed in this journal, is *Actions of Radiations on Living Cells*, by D. E. Lea (QRB 22: 330. 1947). Reviews of others will appear shortly.

FREDERICK W. BARNES



UN SYMPOSIUM SUR LES PROTÉINES. *Médecine et Biologie*, Number 5.

By A. Tiselius, D. P. Riley, E. Gorter, D. G. Derwichian, M. Joly, J. Brachet, P. Rebuffat, R. Vendrely, C. Wunderly, V. Desreux, H. Dieu, M. Dubuisson, J. Jacob, E. J. Bigwood, M. Jutisz, E. Lederer, G. Hamoir, P. Desnuelle, M. Ravery, M. Errera; edited by Marcel Florkin. Masson & Cie., Paris; Editions Desoer, Liege. 440 fr. (paper). 285 pp.; ill. 1947. This small volume presents the proceedings of the

Seventh Congress of Biological Chemistry held at Liège early in October of 1946. It has been put out as the fifth in a series of monographs on medicine and biology under the editorship of Marcel Florkin. The meeting was organized by the Société de Chimie Biologique, and was one of the first post-war opportunities offered our European colleagues for the exchange of information and ideas in the field of biochemistry. The topic they chose to cover centered around the biological and chemical characteristics of proteins.

The book consists of the seventeen papers presented during the symposium, as well as a report of the discussions that followed each contribution. With the exception of one essay, that by Tiselius, all are in French. The topics covered are quite varied in extent. Certain of them may be selected as affording a representative picture of the scope of the conference. Tiselius opened the proceedings with a paper that discussed the methods available for the isolation and identification of protein fragments. He gave a description here of the relatively new procedures being developed in Sweden for separating amino acids and peptides by displacement analysis. This method gives promise of being extremely useful as a tool in the analysis of such problems as the components of the protein molecule. There is also an excellent summary by D. P. Riley of the use of x-rays in the determination of the structure of crystalline proteins. Many American workers will find the contributions by M. Dubuisson and J. Jacob on the proteins of muscle of great interest. These papers contain data on the characterization of what would appear to be components of muscle protein that change in composition during muscular activity. Brachet has contributed a highly stimulating paper on the synthesis of proteins and ribonucleoproteins. Other topics considered are surface chemistry and monomolecular layers, the structure of thymonucleate, the effect of x-rays on nucleoproteins, partition chromatography, and others.

In general, while this book does not contain much that will be new to the American reader of biochemical literature, it is of some value as a means of arriving at an understanding of what our European colleagues are doing and thinking about in this particular field of biochemistry.

S. SPIEGELMAN



CRYSTALLINE ENZYMES. *Number XII of the Columbia Biological Series. Second Edition, Revised and Enlarged.*

By John H. Northrop, Moses Kunitz and Roger M. Herriott. Columbia University Press, New York. \$7.50. xxii + 352 pp. + 17 plates; text ill. 1948.

The first edition of *Crystalline Enzymes* marked the culmination of the second major revolution in the history of enzymology. The first had been the demonstration by Buchner that enzyme activity was a chemical phenomenon, quite separable from the living cell. The second began with Sumner's demonstration, in 1926, that an enzyme, urease, could be isolated as a pure crystalline protein. Sumner's conclusion as to the protein nature of enzymes was subjected to the most rigorous test by Northrop and his colleagues, and the first edition of *Crystalline Enzymes* summarized the methods of enzyme isolation and the data on purity of a number of enzyme proteins.

There is an obvious correlation between this advance, which made it possible to think concretely about enzymes, and the tremendous interest in enzyme reactions that is manifest in all branches of experimental biology today. Not only do we tend more and more to think of biological mechanisms in terms of enzyme reactions, but enzymes are coming into ever greater use as experimental tools. Many a cytologist and histologist will not only read the general discussions in the present work, but will also make use of the detailed "recipes" for the preparation and testing of the enzymes discussed.

In part, the present work, in which Kunitz and Herriot have collaborated with the author of the first edition, continues the plan of that edition. The preparation, behavior, estimation, and criteria of purity are given in detail for a number of enzymes. To the original chapters on pepsin, chymotrypsin, trypsin, and carboxypeptidase (and their precursors and inhibitors) are now added chapters on ribonuclease and hexokinase. There is considerable new material on the older enzymes. There are also chapters on crystalline diphtheria antitoxin and bacteriophage, whose purification was made possible by the methods developed in the preparation of crystalline enzymes. All of this material is given in sufficient detail to be useful to the average chemically-minded biologist.

The new edition also includes several chapters of more general interest. There is an enlarged discussion of the resistance of living cells to enzymes. Northrop has contributed a provocative essay on the question of protein synthesis, considered by some to be the central problem of contemporary biochemistry. In this essay he reviews the small body of existing information and speculation on this question, and advances a working hypothesis of protein synthesis based on the postulation of a "proteinogen," an autocatalytically-reproducing type-protein, from which the numerous specialized proteins of the cell differentiate. This hypothesis is applied to virus formation, antibody formation, and enzyme adaptation. While no direct experimental support of the hypothesis is available, it would seem to be a true working hypothesis, in that a search for the proteinogen should be entirely feasible. It would seem

to be more feasible, however, if greater attention were paid to the structural proteins of the cell, which normally end up in the biochemists' waste crock.

While the field of enzyme chemistry is rich in general works, most of these concentrate on enzyme reactions rather than on the properties of the enzyme molecule itself. *Crystalline Enzymes*, while it does not claim to be comprehensive, is unique in giving the reader the "feel" of the subject of enzymes.

DANIEL MAZIA



ADVANCES IN ENZYMOLOGY And Related Subjects of Biochemistry. Volume VII.

Edited by F. F. Nord. Interscience Publishers, New York and London. \$8.75. xii + 665 pp.; ill. 1947. Volume VII of *Advances in Enzymology* deals with a wide variety of topics, extending from the biochemistry of hypertension to industrial fermentation. It is not to be expected that all of the subjects discussed can be of interest to the general biological reader. In at least a few instances, this expectation is fully realized.

The book starts out with an essay entitled Permeability and Enzyme Reactions, by S. C. Brooks. The title of this essay is unfortunately a literally accurate description of its contents. Both permeability and certain aspects of enzyme reactions are considered. They remain, however, two distinct problems. The attempt to disclose the relations between them is not overly successful. The only connection actually established by the author is that the existence of enzymatic reactions does complicate the classical diffusion approach to permeability. The time would appear to be ripe for an analysis that will at least recognize the possibility that the act of permeation by a molecule or ion may be an enzymatic one and not a mere passive transfer that must precede entrance into the enzymatic reactions of the metabolic cycle.

The second article is by W. Seifriz and is entitled: The Properties of Protoplasm with Special Reference to the Influence of Enzymatic Reactions. The properties considered consist for the most part of physical ones, as, for example: viscosity, elasticity, spirality, etc. The author warns at the outset that "each fact and each hypothesis in this review of the properties of protoplasm is considered quite independently of enzymes, but when experimental evidence indicates that catalytic action is probably involved, then this is stated." In view of the aspects of protoplasmic behavior which have been chosen for emphasis by the author, it is perhaps not surprising to discover that he finds it difficult, if not impossible, to relate his discussion to the facts and principles of modern enzymology.

P. D. Ritchie presents an admirably clear review and

discussion of the problem of asymmetric synthesis. While his viewpoint is primarily that of an organic chemist, he is well aware of the biochemical implications of the experiments he discusses. Biologists will find this article both interesting and informative.

Hevesy, one of the pioneers and founders of modern radioactive tracer methodology, contributes an interesting and scholarly review of recent applications of radioactive indicators. Recent advances in our knowledge of bacterial luminescence have been summarized by F. H. Johnson, one of the active workers in that field.

H. Theorell, an outstanding investigator of the hemoproteins, provides a comprehensive review of the present status of this biological number group. There then follows a discussion by S. Granick and H. Gilder on the related problem of the tetrapyrroles. In this article, the major purpose has been to summarize the available data and methods of attack on the mechanism of pyrrole synthesis. This whole problem has received a tremendous stimulus as a result of the recent discovery by Shemen and Rittenberg which suggests that the initial stage of porphyrin ring synthesis involves glycine as the nitrogenous precursor. The authors have been eminently successful in presenting a clear and readable account which effectively synthesizes the biological and chemical data on this problem.

A noteworthy article is the one by H. McIlwain, entitled: Interrelations in Micro Organisms. The author has considered here a problem to which relatively little attention has been drawn, viz.: the maintenance of adequate levels of coenzymes and other vitamin-like substances which are used in catalytic amounts with very high rates of turnover. The now classic investigation of the Lwoffs on the roles of coenzymes I and II as growth factors for *H. parainfluenza* are summarized here, along with McIlwain's own important contributions on the microbial metabolism of pantothenic acid.

Other topics discussed include: The Oxidation of Organic Sulphur in Animals (Claude Fromageot); Antibiotics from Fungi and Green Plants (F. Kavanaugh); Kidney Enzymes and Essential Hypertension (O. Schales); and finally, Industrial Fermentation (F. M. Hildebrandt). The last article mentioned will undoubtedly be of interest to those who are interested in industrial fermentation, and will unquestionably be informative to those who are somewhat informed on this subject.

As usual in this series, Volume VII is well indexed both as to authors and subjects.

S. SPIEGELMAN



VITAMINS AND HORMONES. *Advances in Research and Applications. Volume V.*

Edited by Robert S. Harris and Kenneth V. Thimann. Academic Press, New York. \$7.50. xvi + 478 pp.; ill. 1947.

This useful set of reviews comprises six on the vitamins and five on the hormones. There is a thought-provoking contribution from the Berne laboratory, in which von Muralt deals with the work on thiamine and peripheral neurophysiology published during the war in journals still lacking in most U. S. libraries. A group of three articles illustrates the inner complexities of steroid hormone administration: Estrogens in the Male Mammal (Emmens and Parkes); Androgens in Women (Carter, Cohen, and Shorr); Testosterone in Man (Heller and Maddock). Melnick and Oser, writing on Physiological Availability of the Vitamins, draw an important distinction between a food's vitamin content and its vitamin availability, and point out that species differences exist with respect to the latter. Two useful special articles by Bird and by Morris concern the specific vitamin requirements of the chick and the mouse, respectively. Other reviews included are: Synthesis of Vitamin A (Milas); The Pteroylglutamates in Man (Darby); Growth and Adrenocorticotrophic Hormones (Li and Evans); Antithyroid Agents (Charipper and Gordon).

Enormous labor goes into the preparation of articles of this kind, which above all are informative. One query, however: Since hormones are part of the subject matter of this series, could not the reviewers more generally add to their burdensome tasks the delightful role of *oïstpos*?

H. R. CATCHPOLE



BIOCHIMIE ET MÉDECINE. *Actualités Médicales.*

By L. Massart. Editions "Erasme" S. A., Bruxelles; Masson & Cie., Paris. 200 fr. (paper). 72 pp. 1947.

In this little monograph an effort has been made to convey within the very restricted compass of seventy pages certain recent developments in biochemistry. Among topics considered are tracer methodology, enzymes, vitamins, hormones, intermediary metabolism, nutrition, etc. The treatment is general and elementary in character, the text apparently being intended for medical practitioners who are desirous of being brought up to date on biochemical research. Examples relating to developments in histochemistry, bacteriology and immunochemistry, chemotherapy, and pathology are given.

The writer devotes a few pages to an appeal for modernizing medical teaching in Belgium. Many of his remarks about the isolation of the medical student from anything but the most superficial contact with

physics and chemistry are applicable not only to Belgium but also to many other parts of the world.

MARTIN D. KAMEN



QUELQUES ASPECTS DE LA CHIMIE DES MÉDICAMENTS.
Médecine et Biologie, Number 7.

By A. Lespagnol. Masson & Cie., Paris; Editions Desoer, Liège. (paper). 205 pp.; ill. [No date].

This 200-page booklet is a collection of lectures that were given before students of pharmacy at the University of Liège. In a well planned introductory chapter on Pharmacodynamic Activity and Chemical Structure, the author deals, among other points, with the effects of optical asymmetry, of isosterism, and of other structural modifications upon the nature and degree of physiological activity and the antagonistic effects produced, e.g., in vitamins, by such modifications. The following chapters are organized according to chemotherapeutic principles, but give as much chemistry, documented by clearly arranged schemes of structural formulas, as pharmacological data. The important advances made in the past decade, in the U.S. as well as abroad, in the study of Hypnotics and Analgesics, Local Anesthetics, and the Morphine group are described. Other chapters deal with such modern developments as natural and synthetic Oestrogens, Ergot Alkaloids, and Antimalarias. From the chapter on the novel Antithyroid Sulfur Derivatives, we learn that the effects of such compounds had been discovered during the war in France, independently of the work in the U.S., by a physician who studied a spontaneous outbreak of goiter in an aminothiazole factory (p. 151). In a chapter on the structure of penicillin, the author apologizes, with a grain of Gallic salt, for the fact that all his information on this subject is by word of mouth—comparing it to tom-tom communication in the African bush—because of the absence of authoritative publications three years after the cessation of hostilities.

Each chapter is followed by a few selected references to important original and review articles. We have found very few factual mistakes. While the information given by Lespagnol is, for the most part, accessible in domestic reviews and textbooks, his monograph will be useful for any pharmacological, medical, and chemical library as a source for French synonyms of chemotherapeutic agents. It will also serve well as reading material for courses in Scientific French, and is apt to dispel our frequently supercilious attitude towards modern French science.

GERTRUDE D. MAENGWYN-DAVIES



ORGANIC SYNTHESIS. *An Annual Publication of Satis-*

factory Methods for the Preparation of Organic Chemicals. Volume 27.

Edited by R. L. Shriner. John Wiley and Sons, New York; Chapman and Hall, London. \$2.25. vi + 121 pp. 1947.

Procedures for synthesizing 36 organic chemicals. Included are β -alanine, 4-ethylpyridine, 1-methyl-1-(1-naphthyl)-2-thiourea, stearolic acid, and other substances of biologic interest. The volume also contains a cumulative index for Volumes 20 through 27 of the series.



PRACTICAL METHODS IN BIOCHEMISTRY. *Fifth Edition*.

By Frederick C. Koch and Martin E. Hanke. A William Wood Book, The Williams & Wilkins Company, Baltimore. \$3.00. x + 419 pp.; ill. 1948.

The latest edition of this well known manual was essentially complete at the time of the senior author's death, the galley proofs having been in his hands. As noted by the authors, the main changes made in the text have been an "expansion of the material on manometric methods, the addition of microbiological methods for vitamins and amino acids and the introduction of new or revised colorimetric and fluorometric methods." The section on microbiological methods describes, in the careful and accurate style characteristic of this book, typical examples of assays conducted with the aid of microorganisms and contains many references to the rapidly growing literature in this field. These include a description of the biochemical mutations of *Neurospora* and their application to this work.

This new edition appears to be in general as up to date as possible in such an active field as biochemistry and within the scope set by the authors, who have intended the manual to be primarily a practical companion to Mathews' *Textbook of Physiological Chemistry*. This scope is of course a broad one and enables the work to serve a variety of interests within its general field.

JOHN E. CUSHING



A LABORATORY MANUAL OF PHYSIOLOGICAL CHEMISTRY. *Sixth Edition*.

By D. Wright Wilson. The Williams & Wilkins Company, Baltimore. \$2.50. 275 pp. 1947.

This book is intended to be used as a teaching manual and not as a comprehensive reference book. Experiments have been chosen to furnish knowledge and experience in biochemical techniques without requiring the extensive use of special apparatus. The manual has

been used by medical, dental, and veterinary students with success. It is clearly printed and well written. Part I deals with general subjects, such as standard acids and alkalis, electrolytic dissociation, colloids, alcohols, carbohydrates, etc. Part II is entitled Body Tissues and Fluids, but deals with muscle, bone, the cell nucleus, metabolism, etc., as well. The manual is recommended to those who do not have special aims and requirements that render the book unsuitable. A reviewer cannot say more than that the course for which this book was prepared appears to be an adequate one.

CHANDLER McC. BROOKS



TECHNIQUES DE LABORATOIRE. *Chimie Physique, Chimie Biologique, Chimie Clinique.*

By M. Abribat, D. Bertrand, C. Carpeni, J. Delsal, P. Desnuelle, D. Dervichian, A. Dobry, A. Dognon, M. Faure, Cl. Fromageot, M. Gaultier, J. Grégoire, P. Grabar, N. B. Halpern, F. Lachampt, Fr. Lachiver, R. Latarjet, J. Leloup, J. Loiseleur, M. Macheboeuf, P. Meunier, J.-J. Pérez, Y. Raoul, J. Roche, A. Rousset, G. Sandor, A.-M. Staub, N. Thoi, A. Vinet, and G. Wolfromm; with a preface by M. J. Tréfouël. Masson et Cie., Paris. 1600 fr. (paper). vi + 907 pp.; ill. 1947.

Prepared by a large group of French scientists, this book is a compendium of techniques employed in physical, biological, and clinical chemistry. The volume opens with a section entitled Généralités, which deals with such varied topics as the calibration of glassware, the preparation of standard solutions and buffers, dialysis, and the calculation of errors. This is followed by a section on physico-chemical techniques of importance to biology: the measurement of pH, viscosity, surface tension, osmotic pressure, redox potential, etc. The third section is devoted to biological chemistry, and includes chapters on the microchemical analysis of the more important elements, methods for the isolation and study of proteins, fats, and carbohydrates, and certain immunological techniques. The book concludes with an account of clinical chemical procedures.

Like all such cooperative enterprises, this volume suffers from unevenness. Some subjects are covered in great detail, some rather cursorily, some not at all, and in addition there are inevitable variations in quality. Perhaps the main defect of the work is its over-ambitiousness. An attempt has been made to cover too vast a field in the space available. Consequently, while the book has the general character of a work of reference, a scientist who wants really thorough information on a specific analytical problem may well be disappointed if he searches for it here. As an example, one may cite

the chapter on the determination of amino acids. This chapter contains detailed descriptions of colorimetric methods for determining fifteen individual amino acids, but it fails to give either methods of separation or alternative methods of determination (e.g., microbial bioassay). The book really falls between two stools—it is too extensive to serve as a laboratory manual, and at the same time it is insufficiently comprehensive to be a really useful work of reference. Despite this drawback, it contains detailed information on many chemical techniques of interest to the biologist.

R. Y. STANIER



LABORATORY INSTRUCTIONS IN BIOCHEMISTRY. *Second Edition.*

By Israel S. Kleiner and Louis B. Dotti. The C. V. Mosby Company, St. Louis. \$2.75 (paper). 245 pp.; ill. 1946.

This is the second edition of a manual originally published in 1940. The text has been altered somewhat by the inclusion of some new procedures, the expansion of sections on calculation, and the deletion of a chapter on food analysis. The material presented is based on courses given by the authors at New York Medical College and is written mainly with the needs of medical students in mind. It does not appear that this manual departs in any significant way from conventional presentations. The print is rather faint, but probably adequate for its assumed life of one year. Large blank sheets are available for student notes. The manual sports a plastic loose-leaf binding.

MARTIN D. KAMEN



A BIOCHEMICAL HYPOTHESIS OF THE GENESIS OF CANCER. *Annals of the New York Academy of Sciences, Volume 50, Article 1.*

By Louis A. Pinck. The New York Academy of Sciences, New York. 50 cents (paper). Pp. 1-18. 1948.

This 17-page pamphlet presents an interesting hypothesis concerning the chemistry of carcinogenic compounds. It is an extension and modification of Fieser's speculations concerning the possible correlation between chemical reactivity and carcinogenicity. Numerous examples of the actual reactivity of cancer-producing chemicals have been given. In other instances the possible reactivity of hypothetical metabolites of carcinogens were discussed. On the basis of these considerations, an attempt has been made to predict that some hitherto unprepared compounds would be found

to be carcinogenic. It is somewhat unfortunate that it has not been possible to include any data on the testing of these hypothetical carcinogens. If and when such data appear, it must be remembered that approximately one out of four compounds tested so far have been found to be carcinogenic.

Most of the common carcinogens have been mentioned and discussed by the author, but it would be interesting to learn how the author would fit such compounds as carbon tetrachloride into his scheme. Then, too, carcinogenic physical agents, such as gamma and roentgen radiation and ultraviolet light, have been omitted from consideration. If Pinck's hypothesis becomes useful in predicting and discovering new carcinogens, these will have to be added to an already crowded list. Finally, if it does become possible to correlate the action of every carcinogenic chemical agent with a specific reactive group such as that postulated here, there will still remain the basic and mysterious problem of how the reactions of these compounds bring about the transformation of a normal to a malignant cell.

FRANK H. J. FIGGE



MICROBIOLOGY

ANNUAL REVIEW OF MICROBIOLOGY. Volume I.

Edited by Charles E. Clifton, Sidney Raffel, and H. Albert Barker. *Annual Reviews, Stanford, California.* \$6.00. viii + 404 pp.; ill. 1947.

This volume is the first of a new series which should be a very valuable companion to the *Annual Review of Biochemistry* and the *Annual Review of Physiology*.

Reviews included are: Morphology and cytology of protozoa (D. H. Wenrich); Antigenic variation in protozoa (J. A. Harrison); Life cycle of malarial parasites (C. G. Huff); Variation in phytopathogenic fungi (C. M. Christensen, E. C. Stakman, and J. J. Christensen); Variation in phytopathogenic viruses (L. O. Kunkel); Some aspects of the problem of growth factors for protozoa (A. Lwoff); Bacterial metabolism (D. D. Woods); Nitrogen metabolism (E. F. Gale); Industrial fermentations (M. J. Johnson); Quaternary ammonium compounds (O. Rahn and W. P. Van Eseltine); Antibiotics (R. G. Benedict and A. F. Langlykke); Chemotherapeutic agents (E. M. Lourie); Immunochemistry (H. P. Treffers); Some aspects of immunization (J. Freund); Medical and epidemiological aspects of enteric infection (A. J. Weil); The rickettsiae (N. H. Topping and C. C. Shepard); and Respiratory viruses (T. Francis, Jr.).

The author index is complete and good. Only one

error was noticed in it. The subject index appears to be somewhat inadequate for a work that contains such a wealth of condensed information. For example, *Mycobacterium tuberculosis* is mentioned under bacterial metabolism (p. 125), under quaternary ammonium compounds (p. 180), and under antibiotics (p. 195), but is not listed in the index. It is true that a detailed subject index would take a considerable amount of space. Nevertheless, the question may be raised whether there should not be a very complete subject index or else none at all. It must be admitted that the indexing of chemical substances is much more complete than the indexing of microorganisms.

Since much of the material is so new, portions of the text approach "mere compilations of the literature" rather than the "critical appraisals" claimed in the preface. This is not the fault of the reviewers. It is due to the fact that the literature contains all sorts of unconfirmed reports, which are seldom if ever refuted because relatively few workers bother to write papers giving primarily negative results, and even fewer editors of journals care to print such refutations. Thus a considerable body of false knowledge is built up (especially in the field of antibiotics) to annoy future students and searchers of the literature.

WALTER C. TOBIE



BIOLOGY OF PATHOGENIC FUNGI. *Annales Cryptogamici et Phytopathologici.* Volume VI.

Edited by Walter J. Nickerson: Foreword by J. G. Hopkins; in cooperation with R. W. Benham, A. L. Carrión, R. Ciferri, C. W. Emmons, J. Lodder, D. S. Martin, A. de Minjer, R. L. Pock, P. Redaelli, M. Silva, J. W. Williams and F. T. Wolf. *Chronica Botanica Company, Waltham, Massachusetts.* \$5.00. xx + 236 pp. + 9 plates; text ill. 1947.

It should be said at the outset that the present volume is not, as its title implies, an account of the biology of pathogenic fungi, but is, rather, an account of the biology of certain fungi parasitic on man. The book is of special interest, therefore, to medical mycologists, dermatologists, and general medical practitioners.

As stated by the distinguished dermatologist, J. G. Hopkins, in his foreword, in this important volume Nickerson has "... collected summaries by pioneers in different phases of the subject. It records what has been accomplished and indicates more emphatically how much needs to be done..." There appear as authors of the various sections of the volume a galaxy of internationally known medical mycologists and investigators. Nickerson has himself not only written an important introductory chapter to furnish a back-

ground for the more specialized sections, but he has also, either alone or with able collaborators, contributed material on the nutrition and metabolism, metabolic products, and respiration and fermentation of human pathogens.

After the foreword and introduction, there follows a chapter by the Dutch investigators, Lodder and de Nimjer, on the biology of the pathogenic *Torulopsis*-doideae. Here, after a historical survey of our knowledge of *Torulopsis neoformans*, virulent parasite of the central nervous system, are considered such topics as the symptomatology and pathology of torulosis, its epidemiology, and its pathogenesis. Material follows on the morphology, and cultural, physiological, and taxonomic aspects of the species. As for all succeeding chapters, a comprehensive bibliography is appended.

Chapter 3, by A. L. Carrión and Margarita Silva, deals with chromoblastomycosis and its etiologic fungi. In the forty pages accorded this topic (the most extensive treatment in the volume) both clinical and mycological aspects of the disease are considered. Under the latter category, morphological and physiological data on the various dermatiaceous fungi commonly considered to cause the disease are included. Briefer accounts of the biology of *Pityrosporum ovale*, the yeast-like organism associated with dandruff scales, and of *Coccidioides immitis*, the cause of "Valley fever," are contributed by R. W. Benham and C. W. Emmons, respectively. There follows a chapter by Ciferri and Redaelli of Pavia on recent advances made by the Italian school of mycopathology from 1941-1945. This discussion covers only taxonomic work, clinical cases being omitted. An important feature of this chapter is a bibliography of 25 titles of Italian papers published during the war years.

F. T. Wolf has contributed a chapter of 23 pages on the action of sulfonamides and antibiotic agents on human pathogens. This is followed by a discussion of the geographic distribution of systemic fungus diseases, by D. S. Martin.

The four remaining chapters deal with the physiological aspects of certain pathogens. Here are included accounts by Nickerson and Williams on nutrition and metabolism, two by Nickerson alone on metabolic products, and on respiration and fermentation, and one by Peck on the lipids of fungi. The volume closes with author and subject indexes.

In assembling "review papers" by authorities in the various fields of the study of human fungus pathogens, Nickerson has done good service both to mycology and to medicine. Although the reader may be at first a bit confused by the variety of subject matter and by the different styles of writing of the thirteen contributors, he will be left with the very definite feeling that there is essential unity in the volume and that this unity

arises from the fact that "... the group of fungi to which these pages are devoted possess in common the ability to parasitize man ..."

F. K. SPARROW



MYCOPATHOLOGIA. *Volume IV, Number 1, 1947.*

Edited by R. Ciferri and P. Redaelli. Dr. W. Junk, Amsterdam. Fl. 36.— per volume of 4 parts.

This journal devoted to mycopathology has resumed publication with Volume IV, Number 1, following a wartime lapse of nearly four years. The five articles in the present issue are all by Italian workers. (One of these contributions, *Die Systematik der Actinomycetinae*, by E. Baldacci, is also obtainable from the publisher as a separate, at a price of f. 2.50). The international character of the journal will no doubt reappear in the next issues.



GENERAL BACTERIOLOGY. *Second Edition.*

By D. B. Swingle; revised by W. G. Walter. D. Van Nostrand Company, New York, Toronto, and London. \$3.50. xiv + 319 pp.; ill. 1947.

Like the first edition of this introduction to bacteriology, the revision, carried out by W. G. Walter, stresses the general biological relationships of the bacteria, molds, yeasts, viruses, rickettsias, and the pleuropneumonia group rather than the great mass of detail found in so many textbooks of bacteriology. In some instances the treatment is almost too sketchy, particularly in the chapter on the history of bacteriology. Relatively little space is devoted to medical aspects of the field, which so often dominate introductory textbooks, but the material has been selected to bring out the fundamental principles of immunity and disease.

Review questions at the end of each chapter deal with the immediately preceding material, are very specific, and in general do not oblige the student to go beyond the book for answers. This means that the questions are not so thought-provoking as they might be.

The book is fairly up to date, an exception being the treatment of the bacterial nucleus and of mutation. The classification used conforms to the 6th edition of *Bergey's Manual of Determinative Bacteriology*. The electron microscope is given its full due, and there is an appreciation of the significance of bacteriophage.

The format is pleasing, with well spaced print and a good quality of paper. The illustrations, many of them

photographs, are clear and interesting. The book is shorter and smaller than comparable textbooks.

SUZANNE GLASS



LABORATORY MANUAL FOR GENERAL BACTERIOLOGY.
Third Edition.

Compiled by George L. Peltier, Carl E. Georgi, and Lawrence F. Lindgren. John Wiley & Sons, New York; Chapman & Hall, London. \$2.50 (paper). viii + 295 pp.; ill. 1946.

This is a loose-leaf, commendably clear laboratory manual that emphasizes general principles and the structure and behavior of groups of microorganisms, rather than the special characteristics of individual species. Thus there is a section on the morphological and chemical nature of bacteria, the species being chosen to illustrate the chief structural and chemical variations as brought out by different stains. There is a section on metabolism and the products of microbial growth, the species used illustrating different kinds of action on carbohydrates, nitrogenous compounds, and lipids, different relationships to oxygen, etc.; and a section on factors that influence the growth of microorganisms, a section of experiments in which various physical and chemical agents are applied to a number of species that differ in the degree to which their growth is affected by such agents. There are also exercises on applied phases of microbiology, including dairy, sanitary, food, soil, and medical bacteriology, and one exercise on the determination of unknown species. Preliminary exercises on the microscope, and on pure culture technique, are given, as well as an introductory survey of microorganisms, including yeasts and molds.

One of the most valuable features of the manual is the list of thought-provoking questions at the end of each exercise. A list of textbooks is provided for reference in answering these questions, but the page numbers given may prove misleading as editions change. A pleasing feature of the format is the provision of adequate space for students' notes.

SUZANNE GLASS



MICROBIOLOGIE GÉNÉRALE ET TECHNIQUE MICROBIOLOGIQUE.

By Paul Hauduroy. Masson & Cie., Paris; F. Roth & Cie., Lausanne. 1250 fr. (paper). 624 pp. 1947. Despite its title, this book is in no sense a treatise on general microbiology, as that term is currently understood. Although the author has attempted to broaden

the scope of his undertaking by the inclusion of brief sections on the history of bacteriology and the biology of microorganisms, his main purpose has clearly been to give a practical account of the principal bacterial agents of human infectious disease, and of the techniques involved in their isolation and study. This volume is essentially a handbook for the laboratory technician.

Following a brief historical introduction (of which more will be said below), a section of fifty pages is devoted to the general biology of microorganisms, the nature of infection and immunity, and the classification of bacteria. At best, fifty pages would allow only a cursory and superficial survey of these important subjects; the treatment here adopted is, however, incorrect and misleading as well as superficial. For example, the author makes no distinction between spirilla and spirochaetes, both groups being dismissed with the astonishing statement: "les spirilles ne rentrent pas à proprement parler dans le monde des microbes tel qu'on l'entend habituellement." The biochemical activities of microorganisms are covered in a single page of trivialities. One cannot help feeling that the author would have been wiser to omit all discussion of these and similar topics.

The third section of the book deals in considerable detail with technical methods for the study of pathogenic bacteria. This is followed by an extended account of the principal bacteria pathogenic for man, with much emphasis on diagnostic procedures. The fifth section describes various special techniques of interest to the medical bacteriologist—water and milk analysis, the determination of germicidal power, penicillin assay—with four pages on mycological technique thrown in for good measure. The book concludes with a hundred pages of formulae and definitions. Much of the information in this section (e.g., the properties of common chemicals, conversion tables, preparation of decinormal solutions) can be found in any chemical handbook and is hence superfluous.

Here one might end, but for—yes, something really must be said about that historical introduction. Like most historical accounts by medical bacteriologists, it ignores the contributions of such masters as de Bary, E. C. Hansen, Winogradsky, and Beijerinck, but in addition it has a much graver defect—a strong aroma of chauvinism. The section opens innocently enough with a chronological tabulation of important discoveries, and this is followed by brief biographies of various bacteriologists. It is not easy to display one's prejudices in tabular form, and the author's attitude only becomes clearly evident in the subsequent biographies. German bacteriologists are coldly dismissed in a few lines, while their French counterparts receive half a page or more of eulogy. One gathers that the French-

men, in addition to being Glories of France, had most of the moral virtues that we associate with the ideal boy scout. Unfortunately for Gallic pride, there is one German who simply cannot be passed off in five lines—Robert Koch. In consequence, Hauduroy devotes over two pages to the assassination of Koch's character, full attention being given to his conflicts with Pasteur and to the fiasco over the announced cure for tuberculosis.

The uninstructed student who may read this alleged "history" would undoubtedly conclude that medical bacteriology had been established by the heroic exploits of a little band of Frenchmen, headed by the almost superhuman figure of Pasteur. A few trivial points were established on the other side of the Rhine, but the German bacteriologists were mostly nasty people, so they don't deserve much scientific credit (vide Koch). Perhaps this is dealing at unnecessary length with a matter better left in silence, but such vulgar distortions of historical fact should not be allowed to appear unchallenged.

R. Y. STANIER



PROPOSED BACTERIOLOGICAL CODE OF NOMENCLATURE
Developed from Proposals Approved by the International Committee on Bacteriological Nomenclature at the Meeting of the Third International Congress for Microbiology. Publication authorized in Plenary Session.

Edited by R. E. Buchanan and Ralph St. John-Brooks.
The Iowa State College Press, Ames. \$1.00 (paper).
61 pp. 1947.



PARASITOLOGY

LABORATORY DIAGNOSIS OF PROTOZOAN DISEASES.
Second Edition.

By Charles Franklin Craig. Lea & Febiger, Philadelphia. \$6.50. 384 pp. + 7 plates; text ill. 1948.
In 1942 Colonel Craig published a book that was welcomed by all persons attempting to diagnose the protozoan diseases of man. It presented detailed descriptions of a wide variety of laboratory diagnostic techniques, with evaluations by the author. That exceedingly practical and valuable book has now been brought up to date by a second edition.

Due to the impetus of World War II, a great deal of work was done on perfecting parasitological procedures. The author has selected from the newer work those developments that he feels to be most significant. Only

a few of the new additions can be cited here. Several new staining methods for intestinal protozoa have been added. Hakansson's aqueous smears for the diagnosis of *Dientamoeba fragilis* and the destruction of *Blastocystis hominis* has been recommended. Among other cultivation methods, Nelson's alcohol extract medium for *Endamoeba histolytica* and Lourie's, Senekjic's, and Weinman's media for the hemoflagellates are included. The recent work on the successful cultivation of malarial parasites by Ball and his co-workers is discussed but not presented in detail, since the method is not a practical diagnostic procedure. The J.S.B. method of staining malarial parasites in thin and thick blood films is given.

Not only has the book been improved by the addition of recent developments but also by the inclusion of valuable earlier work that did not appear in the first edition. For example, Quensel's method of staining amoebic trophozoites in temporary mounts is now described and recommended.

With the exception of the addition of new techniques, the second edition is very similar to the first. A few additional illustrations have been added, while those reprinted from Aimee Wilcox's manual greatly improve the chapter on the diagnosis of malarial parasites in thick blood films. The list of references has been increased by nearly one hundred articles, although it should still not be considered as complete.

M. M. BROOKE



MANUAL OF MEDICAL PARASITOLOGY: *With Techniques for Laboratory Diagnosis and Notes on Related Animal Parasites.*

By C. Courson Zeff. State College, Pennsylvania.
\$3.75 (paper). xiv + 159 pp. + 1 plate; text ill.
1947.

Despite its faults, which on the whole are minor, this manual should prove to be exceedingly useful in college and university courses devoted to medical parasitology. It is primarily a laboratory guide, presenting the morphological details of the organisms and the various diagnostic techniques.

The characteristics of the parasites are presented in keys, tables, charts, and illustrations reprinted from other textbooks. Unfortunately some of the illustrations have lost considerable clarity, as a result of being considerably reduced in size. A colored plate reprinted from the manual by Huff, 1944—by typographical error acknowledged to "Hoff"—adds materially to the attractiveness of the manual.

The author is to be commended on familiarizing the student with some of the recent parasitological litera-

ture. References to original articles are cited in the text and in footnotes along with some of the conclusions of the authors. At the end of the manual there is a list of the major textbooks, manuals, and journals devoted to parasitology. A number of features in the manual should greatly assist the student. There are sections devoted to medical terms, to basic parasitological definitions, and to terminology. The etymology of the generic and species names of the important parasites is given, in order to help to explain some of the complicated names that have been given to the human parasites. A detailed index and table of contents will assist the student to locate desired information.

Unfortunately there are a number of typographical errors. Heidenhain is misspelt "Haidenhain", Chagas' disease becomes "Chaga's". The lack of a comma between "Sen Gupta" and "Napier" might lead the student to interpret these as the name of a single investigator. In describing the cysts of *Endamoeba histolytica*, the word stain is used in the place of strain in the following sentence: "Cysts are about 5 to 20 μ in diameter according to the stain."

About one-third of the manual is devoted to laboratory diagnosis and laboratory technique. A wide variety of procedures is presented in considerable detail. At the end of this section directions are given for the preparation of solutions, stains, and reagents.

M. M. BROOKE



VETERINARY PROTOZOLOGY.

By Banner Bill Morgan and Philip A. Hawkins.
Burgess Publishing Company, Minneapolis. \$4.00.
x + 195 pp. + 1 plate; text ill. 1948.

Veterinary protozoology has become increasingly important during the past few decades, and it is timely for a textbook dealing exclusively with the protozoan diseases of veterinary importance in North America to be published. The present book has grown out of the teaching materials that the authors have used in courses on the subject at the University of Wisconsin and at Michigan State College.

After an introductory chapter devoted to general aspects of protozoology, separate chapters consider the protozoa of horses, cattle, sheep and goats, swine, dogs and cats, poultry, and furbearers. The clear, concise presentation of the morphology, life histories, pathology, diagnosis, treatment, and control of the parasitic protozoa will be appreciated by both practising veterinarians and others who are concerned with this field parasitology. All four classes of the Protozoa have parasitic representatives to be found in most of the domesticated animals discussed. The flagellates and sporozoans are the ones most frequently incriminated as the cause of disease. The amoebae are relatively unimportant, and although ciliates are in great abundance

in some hosts, they are apparently harmless. Poultry seem to have the greatest opportunity of being adversely affected by protozoans, and species of the Coccidia are probably the greatest offenders.

The book contains 24 excellent plates with large illustrations of the various protozoa discussed. A number of the figures have been redrawn from other authors, but many are new. Unfortunately, there are no references to the figures in the text, which may be a handicap for some. Three maps present the distribution of dourine anaplasmosis and *Boophilus annulatus* in the United States.

There is a brief chapter on the diagnosis of the protozoan diseases that presents many of the standard parasitological techniques. The appendix includes a parasite-host list, treatment schedules for the most common protozoan diseases, a list of important books and journals, and a bibliography of 309 articles of interest to veterinary protozoologists.

M. M. BROOKE



HEALTH AND DISEASE

PHYSICAL FITNESS, APPRAISAL AND GUIDANCE.

By Thomas Kirk Cureton; assisted by Frederick W. Kasch, John Brown, and W. G. Moss. The C. V. Mosby Company, St. Louis. \$6.00. 566 pp. + 1 chart; text ill. 1947.

The problem of differentiating between health or normality, on the one hand, and poor health in the absence of disease, on the other, frequently presents a formidable problem. Where there is disease, the accepted procedures of diagnosis are usually of value. The relation of "health levels" to productivity, social adjustment, and the happiness of individuals is no less important, however, and despite much work it is, as this book silently attests, an elusive thing.

The authors are under no illusions about the evaluation of health levels and physical fitness. Their first chapter deals with the central question: What is physical fitness? This is easily answered for the authors, by a complicated chart of concentric rings in which organic condition is at the center, surrounded successively by physique, motor fitness, sensory fitness, and skills. The ideal is, apparently, to score well in each of these areas. Given a normally functioning body, the individual, in order to be ideally physically fit, must enjoy gymnastics, aquatics, skiing, skating, ball games, racquet games, sailing, camping, etc., etc. Fitness in these activities naturally depends upon the other more central features of fitness noted above. Physical education, therefore, is related to physical fitness in so far as it develops habits, understanding, and skills about one's self with respect to physical fitness and sports. This all makes good sense, so far as it goes. It leads the

authors next to consider the best tests for physical fitness. There follow thirteen chapters, in five sections, dealing with: Physique; Cardiovascular Condition; Respiratory Fitness, Motor Fitness; and Guidance.

The chapters that make up the bulk of this textbook are full of facts, methods of measurement, methods of tabulating data and for scoring fitness. These will be of utmost value to those who are concerned with physical education. The book ought to be of equal value to physiologists, psychologists, and sociologists, however, and should stimulate them to inquire: Are mere physical endurance, stamina, and motor skill necessary conditions for a productive, happy, and socially well adjusted life?

The physiologist will look at many of these tests with a critical eye. There is no doubt that they measure something, but what is it? Are they tests of tests? The discussion of somatotypes, for example, is complete and will satisfy those who must measure somatotypes. Yet there is no doubt that many of the conclusions reached in this discussion are empirical and lack a scientific basis of fact. The discussion of the Cureton technic for measuring body fat shows it to be empirical, too. Data are obtained by it and described in detail. Now no one will deny that extremes of fat and thinness are undesirable, but what constitutes a *significant* increment of fat? In this test, numerical scores are obtained and letter grades are assigned for fat in cheek, abdomen, hip, gluteal region, and rear and front thigh. A critical reader will want to know how a score of D is any more indicative of poor "physical fitness" than one of C. Nowhere in the discussion of the relation of weight to physical fitness is there any mention or evaluation of the specific gravity test developed by Keyes. Is it useful or not? In a book on the appraisal of physical fitness, the student wants full discussion and evaluation by the experts.

The section on tests for cardiovascular fitness are most complete, and all who need to apply them will find here a useful compendium. He will also find a fair account of their physiological basis. There is again lacking, however, a critical evaluation of how the results of these tests are actually related to physical fitness in a fundamental sense. The pulse-scoring tests, for example, are among the most favored tests for evaluating physical fitness; yet it is known that frequently older individuals may obtain high scores, or that individuals without much endurance (e.g., those with rheumatic or other types of heart disease) may score high. This is not so much a criticism of the book under review as it is a plea for less emphasis generally on numerical scores as a means of judging fitness. The use of the heartometer provides a case in point. An excellent description of the use of this instrument for analyzing pulse waves is given, and many tests with it are cited. Numerical data concerning the characteristics of pulse waves are quoted in extenso, with standard scores for

excellent, very good, good, average, fair, poor, and very poor. The percentile distribution of these is given. If, then, we speak of the frequency of a score, that is one thing, but if one goes on to state what is a "good" and what is a "poor" score, he transgresses, it would seem, the limits of scientific objectivity. Other criticisms are equally apt. One might question the use made by the authors of the "angle of obliquity" in the systolic peaks of the heartogram pulse wave, since it is constructed arbitrarily with one *straight* side although the writing arm inscribes a radius of *curvature*.

One might go on to question the significance of one or another aspect of these tests used to measure fitness. To do so, however, would detract unnecessarily from the value of a large job which has been done clearly and well. If a deficiency exists, it resides basically in the failure of physiologists to define clearly what fitness and fatigue actually are. The psychological aspects of motivation are of utmost importance, yet they do not, to judge from this volume, enter into ordinary procedures for evaluating fitness.

S. R. M. REYNOLDS



PHYSICAL FITNESS WORKBOOK. *A Manual of Conditioning Exercises and Standards, Tests and Rating Scales for Evaluating Physical Fitness.*

By Thomas Kirk Cureton. The C. V. Mosby Company, St. Louis. \$2.50 (paper). xii + 150 pp.; ill. 1947.

The subtitle to this publication tells in essence what the book is. It is designed as a personal record book for all undergraduates who participate in the Physical Fitness Program at the University of Illinois. The manual is rich in test procedures and scoring methods. It has sections on Measuring Individual and Group Performance and Improvement in Physical Fitness; Use of the Work Book; Illinois Motor Fitness Screen Test; Motor Efficiency Classification; An Inventory of Motor Fitness; Commands, Formations and Lesson Plans; Introductory Flexibility Tests; Tumbling Stunts and Grass Drills for Conditioning, Balance, Flexibility and Agility; Agility Conditioning Field Exercises; Posture and Physical Development Exercises; Weight Lifting and Strength Exercises; Medicine Ball Exercises; Competitive Games and Contests; Stamina Building Routines; Somatotype Rating and Overall Evaluation of Physique; Respiratory Tests of Organic Efficiency; The Schneider Test of Cardiovascular Efficiency; the Pulse Ratio and Step Tests of Cardiovascular Deficiency. A long appendix contains rating scales and tables for the physical fitness tests and measurements.

Except at the University of Illinois, where this manual is integrated with a large program, this publication will be of most use to teachers of physical edu-

cation. It should also serve as a stimulus to physiologists to determine in what way and to just what extent many of these tests do bear a relation to physical fitness. Their relation to age, previous personal history, and occupation might also be evaluated with interest and profit.

S. R. M. REYNOLDS



SCOLIOSIS: *The Practical Approach to Treatment.*

By Beatrice Woodcock. Stanford University Press, Stanford University, California; Geoffrey Cumberlege, Oxford University Press, London. \$2.00. xiv + 111 pp.; ill. 1946.

In this book the author presents her views on the types of exercises which she considers to be indicated for cases of lateral curvature of the spine. The first part of the book is intended to lay the ground-work for a logical explanation of the "derotation" method of treatment that the author stresses. One is kept in suspense about what this "derotation" is until a third of the way through the book.

With Part II, the attempt at a scientific and logical explanation is dropped, and one reads that "by consensus of expert opinion we know in which direction to rotate the rotating vertebrae"—a statement which is given as proof that the procedure is logical. The authorities named are indeed to be considered, but others have been known to disagree with their views.

In an uncompensated curvature there is justification for a procedure which attempts to make an "S" curve out of a "C" curve, and to this end the type of exercises outlined by Beatrice Woodcock will find a usefulness. In functional "C" curves, or beginning compensatory curves in which treatment may properly be directed toward a correction of the defect in the direction of normal alignment, the type of exercises outlined in this book are definitely contra-indicated.

The references to muscle weakness as found in typical scoliosis cases are vague in some instances, and definitely incorrect in other instances. There is no clear-cut picture which indicates that the author understands the muscle imbalances as they occur in scoliosis. Exercises to stretch certain muscle groups are described as essential to reestablish normal flexibility. Exercises which lay stress on strengthening these same muscle groups are elsewhere in the book claimed to be of therapeutic value.

From a technical standpoint, a number of misleading statements are scattered throughout the book. For example, the right-angle relationship of the trunk to the legs in the sitting position with legs extended forward is considered a correct sitting position by the author in describing free movement. This position is definitely an abnormal posture for the average, normal individual.

There is a very definite need for a book on conserva-

tive exercise therapy in scoliosis, but this book does not answer that need. The routine presented should be applied only to those cases in which compensation is the treatment of choice.

HENRY O. KENDALL



HISTOPATHOLOGIC TECHNIC.

By R. D. Lillie. The Blakiston Company, Philadelphia and Toronto. \$4.75. xii + 300 pp. 1948.

The author is a well known pathologist who for many years has been interested in the principles underlying the staining of tissues as well as the improvements that can be achieved in the various uses of stains. He has contributed fruitfully to this field in the past, and the present volume reflects his interest and wide experience. Designed primarily for the use of clinical and anatomical pathologists, the book ought to serve as a handy reference and guide. The subject matter is handled in an orderly sequence starting with microscopy, equipment, fixation, etc., and including chapters on nuclear stains, cytoplasmic granules, enzymes, endogenous and exogenous pigments, various cell products, fats and lipoids, and connective and nervous tissue respectively. There is also a chapter on special procedures, such as corrosion technics, autoradiography of radioactive elements, and microincineration.

Not intended to be of encyclopedic scope, the volume contains procedures and innovations which the author for the most part has tried and found to be satisfactory. In that sense it presents some of the more recent advances in this field.

C. A. KRAKOWER



PATHOLOGICAL HISTOLOGY. *Third Edition.*

By Robertson F. Ogilvie, with a foreword by A. Murray Drennan. The Williams & Wilkins Company, Baltimore. \$10.00. xii + 459 pp. + 143 plates. 1947.

The appearance of the third edition of this volume, first published in 1940, is an index of its popularity and usefulness. Within its 447 pages of text it packs an enormous amount of information, covering the gross and microscopic features of pathological lesions in their whole pathogenetic range. The unique feature of this volume, however, is that there are 258 colored photomicrographs which are faithful reproductions of stained preparations and illustrate the lesions described in the text. These reproductions, in fact, almost constitute a good class set of slides in pathology. Armed with such a class set and this volume, the student and post-graduate should make fast headway in learning or refreshing his memory of an important field in medicine.

C. A. KRAKOWER

RECENT ADVANCES IN PATHOLOGY. *Fifth Edition.*

By Geoffrey Hadfield and Lawrence P. Garrod. *The Blakiston Company, Philadelphia and Toronto.*
\$6.00. viii + 363 pp. + 31 plates; text ill. 1947.

This volume will be of interest to the graduate pathologist, medical practitioner, and anyone who desires a refresher course in pathology or a summary of recent advances in scientific information in the fields of anatomical, physiological, and experimental pathology. Certain omissions detract from the value of the new edition. The repetition of numerous chapters, unrevised, from the fourth edition prevents the information in many fields from being up to date. The consideration of rheumatic fever suffers in the latter respect; and experimental work that has clarified the pathogenesis of lupus erythematosus disseminata and periarthritis nodosa and other so-called "collagen" diseases has been completely omitted. Chapters repeated without revision are those devoted to hypersensitive states, the reticulo-endothelial system, hypertension, the ductless glands, and the digestive tract. Little has been added to discussions of diseases of the respiratory system, except for a study of silicosis, in spite of the fact that a great deal of knowledge on "atypical" and virus pneumonias has occurred in the past few years. Vitamin diseases, though summarized in the fourth edition, are not included in this volume; and the only information in the field of hematology, as before, is upon the relation of gastric and intestinal function to anemia.

The most complete and up-to-the-minute revision is on liver disease. Here there is an excellent summary of epidemic hepatitis and the relation of dietary deficiencies to hepatic disease. The chapter on nephritis has also been rewritten and simplified, unfortunately before the recent work of Trueta and his co-workers became available. Recent work on experimental cancer research forms an interesting chapter. Information as to the site of antibody formation has been added to this edition; and Menkin's work on inflammation is carefully reviewed, along with the objections to it raised by other investigators. There is also an interesting summary on the nature and effect of the "spreading factor" in inflammation. The illustrations, although not numerous, are well chosen. The bibliography is complete to the point reviewed for each subject.

ELLA H. OPPENHEIMER



A TEXTBOOK OF CLINICAL PATHOLOGY. *Third Edition.*
Edited by Francis P. Parker. *The Williams & Wilkins Company, Baltimore.* \$9.00. xx + 1023 pp.; ill. 1948.

This is the third edition of the excellent textbook of clinical pathology formerly edited by Kraske in collaboration with Parker. In this edition Parker has con-

tributed chapters on blood chemistry, renal and hepatic function, the examination of urine and seminal fluid, and the examination of gastric contents. Kraske has contributed a chapter on the disorders of the leucocytes; and six other contributors, all experts in their fields, have written the material devoted to hematology, including methods of examining blood and bone marrow; blood grouping, including the laws of inheritance of blood groups; diagnosis of blood parasites; the assay of vitamins and hormones; the examination of sputum, including the detection of fungi and bacteria; the examination of feces, cerebrospinal fluid, exudates, and transudates; the examination of the skin and mucus membranes; immunologic tests; the diagnosis of venereal diseases and the serologic tests for syphilis.

The third edition has been completely rewritten, the material from past editions has been modernized, and the new procedures developed in the past six years have been added. For instance, in the chapter devoted to blood grouping, recent knowledge of the Rh and Hr factors has been summarized, as well as the interrelation of the subgroups of groups A and AB. In the section upon hemorrhagic and thrombo-embolic disease, dicumoral and heparin therapies are discussed; and the section on blood chemistry now includes the most recent methods of analysis.

The clinical procedures for the collection of material to be examined are described in detail, and many illustrations demonstrating techniques give additional aid to the novice. The normal standards are fully summarized for every study, and the pathology and pathogenesis of abnormal findings are amply described. Throughout the book, emphasis is placed upon the interpretation of clinical findings, and this makes the work a valuable reference book. In addition, it is an excellent general textbook of clinical laboratory procedures for the medical student and should be kept in every clinical laboratory.

ELLA H. OPPENHEIMER

THE PATHOLOGY OF TRAUMATIC INJURY. *A General Review.*

By James W. Wilson, foreword by Philip H. Mitchiner.
A William Wood Book, The Williams & Wilkins Company, Baltimore. \$6.00. xii + 192 pp.; ill. 1946.

This monograph on the pathology of trauma is a concise summary of scientific data compiled from recent wartime and experimental studies. It includes a comprehensive clinical survey of each subject, thereby making this work of special value to the physician or surgeon in the treatment of accident cases. It should also serve as a valuable adjunct in the accident wards of hospitals; and the teacher and student of pathology and clinical medicine will also find it of interest.

All subjects based on trauma are included in this volume—shock, burns, fat embolism, blast injury, wounds, and injuries to specific tissues. In the discussion of shock, functional pathology is stressed, and the principles of the treatment of shock, advocated by the author, are based on its pathogenesis. The chapter on burns includes pathological and experimental studies as well as a discussion of possible complications and methods of treatment. There is an excellent account of the pathogenesis of the crush syndrome and of blast injuries. Modern knowledge pertaining to the causes and pathogenesis of fat embolism are summarized. The chapter on wound pathology is excellent and devotes considerable space to complicating infections, including tetanus and gas gangrene. The factors which influence healing are discussed as a basis for treatment. There are chapters on the pathology and sequelae of closed, penetrating, and open wounds of the chest, abdomen, and pelvis and their viscera; vascular injuries and their complications, injuries to the head and central nervous system; and the pathology and healing of fractures and joint injuries. The illustrations are well chosen and there is a comprehensive bibliography on each subject, so that this work gives a complete survey of the specific subjects related to trauma.

ELLA H. OPPENHEIMER



CARE OF THE BREAST.

By *Else K. La Roe*. *Froben Press, New York*. \$3.75. xvi + 246 pp.; ill. 1947.

This is a compilation of accredited facts mixed with fanciful hypotheses of historical, anatomical, physiological, pathological, clinical, and therapeutic data on the subject of the mammary glands. The material is presented in slipshod and repetitious fashion, with a bias that is amazingly naive. For the author devotes the greater part of the volume to her personal theories and classifications, including her theory of the origin of cancer, her methods of breast examination, her brassiere developed on "Langer skin tension lines"; and her "slanting" technic and "tunnel graft" methods of plastic breast surgery, used by her for aesthetic purposes as well as for medical necessity.

The usefulness of this volume appears to be limited. The surgeon will need a more comprehensive survey of the literature and would find this quite superficial; the medical practitioner, however, might find the survey of sites of origin of specific tumors and their relation to age groups of practical value and interest. The pathologist must shudder at the unscientific classifications and the complete lack of use of histology in the differentiation of disease. Many of the illustrations should interest a medical historian. Undoubtedly the layman—or rather the laywoman—is the person who will be most interested in this book; and its scientific terms are

amply defined for her in the glossary. The author's intention is to make women "breast conscious" and "aware that a competent doctor should be consulted at the first sign of any change or peculiarity" in the breasts, so as to facilitate an early diagnosis of cancer and thereby to reduce its dangers.

ELLA H. OPPENHEIMER



TUBERCULOSIS. *A Discussion of Phthisiogenesis, Immunology, Pathologic Physiology, Diagnosis, and Treatment.*

By *Francis Marion Pottenger*. *The C. V. Mosby Company, St. Louis*. \$12.00. 597 pp.; ill. 1948.

Every chapter of this clearly organized and richly illustrated handbook on tuberculosis is an authoritative document of the broad-minded scholarship of an experienced clinician, one who may well be proud of "the more than 50 years spent in the practice of medicine." His approach to the clinical and etiologic aspects of the disease is largely immunologic and always remains free of unwarranted or dogmatic assertion. The presentation is concise, reasonably optimistic, and in excellent style, and there is little doubt in the reviewer's mind that the new book ranks with the best written on the subject.

Of particular interest to genetically oriented readers will be the author's confession to having "very little phthisiophobia," as well as his emphasis on the part played by inherited tissue qualities in "protecting one person and making another vulnerable." Tuberculosis he looks upon as a mildly infectious and potentially curable disease, which in this country has passed from the epidemic to the endemic stage and therefore affords great opportunities for preventive measures through an increased amount of attention to the most susceptible persons. Primary infection is regarded as "a vaccination," and the decline in the incidence of the disease Pottenger ascribes mainly to the steady elimination of the most susceptible.

FRANZ J. KALLMANN



LE GRANULO-DIAGNOSTIC DE LA TUBERCULOSE.

By *R. Benda*. *G. Doin & Cie., Paris*. 115 fr. (paper). 96 pp. + 2 charts; text ill. 1945.

The hematologic data presented in this small but well-documented monograph were obtained with May-Gruenwald-Giemsa stain in a fairly large series of infected patients, as well as in guinea pigs inoculated with human blood serum or tuberculous sputum. In accordance with the observations of Matis (1928), Lambin (1929) and Sandels (1938), the presence of many gross, irregular granulations in the cytoplasm of neutrophile polymorphonuclear leucocytes was found to

be a typical feature of acute cases of tuberculosis, as distinguished from such infections as pneumonia, rheumatic fever, leprosy, and subacute bacterial endocarditis. This finding was used for the development of a scheme of "granulograms" classified as normal, intermediate (\pm), medium (+), or extreme ($++$), according to the size, shape, and density of the granulations observed. Extreme granulograms were seen only in clinical tuberculosis, while the medium type occurred during the first week of typhoid fever, and the intermediate type in some cases of Boeck's sarcoid.

The author appears sufficiently optimistic about the practical applications of this cytological method to recommend its routine use in the management of tuberculosis for both diagnostic and therapeutic purposes. If confirmed as to reliability, the method may prove to be of considerable clinical value, since it is described as being economical and technically simple.

FRANZ J. KALLMANN



OCCUPATIONAL DISEASES OF THE SKIN. *Second Edition.*

By Louis Schwartz, Louis Tulipan, and Samuel M. Peck. Lea & Febiger, Philadelphia. \$12.50. 964 pp. + 1 plate; text ill. 1947.

No book in the English language presents so complete and authoritative a discussion of this subject as this one. It is large, comprising 964 pages, and represents almost a lifetime of painstaking work. Dermatologists, industrial physicians, and medico-legal experts refer to it constantly. With all respect to the authors, however, one may still say that it is not comprehensive enough. The hazards of one hundred and fourteen occupations are discussed. Should there be a subsequent edition, the authors might lengthen the list and broaden the discussions of the hazards, for some have not been mentioned in this work.

A considerable portion of the book is taken up with discussions of diseases which are only indirectly occupational in certain instances, such as parasitic infections, bacterial infections, fungus infections, and venereal diseases. Another portion is devoted to the medico-legal aspects of occupational dermatoses.

The index is too short and is highly technical. It is often difficult for the reader, who may lack detailed technical knowledge of the manufacturing processes and chemicals used, to find what he wants to know in the book.

H. HANFORD HOPKINS



BEAUTY PLUS—*The Key to Beauty, Health, and Charm. Revised Edition.*

By Mary MacFadyen; illustrated by Frank H. Netter. Emerson Books, New York. \$2.49. 272 pp. 1946.

This is a small book, but it contains 272 pages and 36 chapters. It has been written by a woman physician for women in general. A lot of territory is covered. A woman can use it as a reference book on cosmetology, posture, exercise, eating habits, drinking, smoking (including "hang-overs"), minor ailments, or her sex life from infancy to after menopause. The subject matter is presented clearly, concisely and simply. The reader should, however, not take everything said as the last word on the many subjects covered, and should avoid the dangers of too much self-treatment, which might be stimulated by too close an adherence to the advice offered in the text.

H. HANFORD HOPKINS



INTERNATIONAL DRUG CONTROL. *A Study of International Administration By and Through the League of Nations.*

By Bertil A. Renborg. Carnegie Endowment for International Peace, Washington, D. C. \$2.50. xii + 276 pp. 1947.

This study of the narcotic drug problem has been written by the former Chief of the Section of the Drug Control Service of the Secretariat of the League of Nations, B. A. Renborg. He describes the supervision and control of narcotic drugs at the domestic and international level. The purpose of the volume, says the author, is to demonstrate what it is possible to achieve by international cooperation in a campaign against a common enemy of mankind. The results obtained by international cooperation in the narcotic drug field are outstanding. Narcotic drugs are indispensable to medical practice but they constitute a grave public danger when abused. The nations of the world have recognized this problem and by common agreement have placed themselves under supervision by international bodies. The results have been successful beyond the fondest hopes of the early planners. Today the spirit of international cooperation engendered in narcotic drug control is pointed to as a model of what may be accomplished by supervision and regulation of problems at the international level. The hopeful suggestion is made by Renborg that arms, munitions, and instruments of war present a danger to humanity analogous to the danger from narcotic drugs. Unless controlled by responsible authorities, weapons, like narcotics, present a danger to the individual, to the nation, and to mankind as a whole. The common danger inherent in narcotic drugs and implements of war always depends upon voluntary acts of individuals or organizations. This characteristic separates such dangers from others of international scope, as, for instance, epidemic diseases; for the latter may spread from one country to another independently of the deliberate acts of man.

In 1920 the members of the League of Nations agreed under the Covenant to entrust the League with general supervision over the execution of agreements with regard to the traffic in opium and other dangerous drugs. There then began a new phase of international cooperation in the campaign against the abuse of narcotics. The League created an administration which functioned, by common agreement among the states, on the basis of international conventions through which governments undertook obligations to submit the manufacture of and trade in narcotic drugs to stringent measures of national and international supervision and control.

The author gives an account of these activities of the League and of the system developed for international control. The record has factual value and demonstrates the success achieved for more than twenty years in world cooperation. With the dissolution of the League of Nations, its functions in this field were transferred to the United Nations. The work is now continued by the Commission on Narcotic Drugs of the Economic and Social Council of the United Nations.

There does not exist today an internationally recognized definition of the term "narcotic drug." Experts in this field have been unable to propose a definition that might be recognized internationally. The difficulty was "partly one of language, since several terms would be required to indicate with scientific precision the different kinds of drugs covered by the Convention, some of which are narcotic and habit-forming, some narcotic but not habit-forming, and some neither narcotic nor habit-forming but convertible into habit-forming narcotic drugs." Modern pharmacology should provide a terminology that would bridge this serious handicap. New synthetic narcotic substances that have recently been discovered, e.g., Demerol, will add to the difficulty of selecting a generic term suitable for the purpose of international control.

To those who have been interested in the narcotic drug problem this book will provide factual data for classroom and lecture presentation. To students of the larger problem of international relations, the record of experience provided by narcotic drug control will furnish an outstanding example of the necessary coordination in control between international authorities that must be achieved to solve problems which extend across boundaries and affect the interests of individuals and nations.

C. JELLEFF CARR



MIRACLE DRUG. *The Inner History of Penicillin.*

By David Masters. Eyre & Spottiswoode, London. 10s. 6d. 191 pp. + 17 plates. 1946.

This is a very concise and chronologic story of the interesting development of penicillin. The author

gives a vivid account of the work from the original observation made by Fleming to the time when mass production of penicillin on a commercial scale was accomplished in England. It is cleverly written. It contains many interesting side lights on the struggles and devotion of the scientists in London and Oxford to their work, which will ever live as a monument to their unselfish service to medical science. The author has a tendency, however, to overwork his thesis slightly in what appears to be an attempt to establish the fact that the development of penicillin was a British accomplishment. Among scientists, this has always been recognized.

The story is very readable and has much human interest. From the point of view of a scientist, however, it contains little that is not well known to students of microbiology who have followed the development of penicillin.

W. E. HERRELL



DISEASES OF THE NERVOUS SYSTEM. *Described for Practitioners and Students. Fifth Edition.*

By F. M. R. Walshe. The Williams & Wilkins Company, Baltimore. \$4.50. xvi + 351 pp. + 22 plates; text ill. 1947.

The fact that it has become necessary to reprint this book eight months after the issue of its fifth edition is a sufficient indication of its value. It is unfortunate that the author has tried to deal with the subject of the psychoneuroses. The chapter on that subject does not reflect a modern viewpoint and has had to be so cursory as to be almost valueless.

The book is intended for the use of students and practitioners and is not only sufficiently comprehensive to satisfy all their needs, but it is excellently indexed and can therefore serve as a useful reference book.

The principles of neurological examination and diagnosis are clearly and logically presented, and the whole field is comprehensively and concisely covered.

DAVID ROSS



MEDICINE IN THE POSTWAR WORLD. *The March of Medicine, 1947. Number XII of The New York Academy of Medicine Lectures to the Laity.*

By The New York Academy of Medicine. Columbia University Press, New York; Geoffrey Cumberlege, Oxford University Press, London and Bombay. \$2.00. xiv + 109 pp. 1948.

This little book comprises six lectures that relate particularly to the effect of wartime experiences on medicine itself. Possibly the most significant thing about it is that, of the six lectures, three are devoted directly to psychiatric problems, and that most of the others have a bearing on social medicine. Nothing in the book will

be found new or startling to the medical reader, but there is a great deal which can be read with profit by medical men and biologists, even though couched in language readily understandable to "the man in the street." The lecturers are men of authority in their own spheres, and their approaches to their several subjects are stimulating.

DAVID ROSS



PSYCHOLOGY AND ANIMAL BEHAVIOR

PSYCHOLOGY FOR LIVING.

By Herbert Sorenson and Marguerite Malm.
McGraw-Hill Book Company, New York, Toronto, and London. \$3.00. x + 637 pp.; ill. 1948.

This is a textbook of general psychology for high school students. For this reason, the material covered is not quite the same as one usually finds in introductory college textbooks. There is considerable emphasis, for example, on the personal problems of high school students—how to study, worries, dating, marriage, and choosing an occupation—while such academic topics as sensation, perception, attention, and maze learning are either ignored or mentioned only briefly. This does not mean that the book is unbalanced. The contents appear to be well adapted to the interests and needs of high school students. As a matter of fact, it is rather surprising to find how many fairly advanced ideas, derived from studies of the emotions, learning, intelligence, individual differences, and the like, the authors have been able to present in a way that should make them seem real and important to the student.

In other respects, too, this book seems particularly well suited to its intended audience. The authors' style of writing is smooth and simple without being juvenile or offensive. The book is liberally sprinkled with clear, interesting illustrations. In the appendix there are (1) a list of books on vocations, (2) a glossary of technical terms, (3) a list of books on psychology and related problems for students who are interested in further readings, (4) a list of books to assist the teacher in locating material for lectures, and (5) a source list of visual aids.

This is, it seems, the kind of book every high school student should read. It is well-written, interesting, and, unlike so many popularized books on psychology, crammed full of sound, authoritative psychological information.

A. CHAPANIS



GESTALT PSYCHOLOGY. *An Introduction to New Concepts in Modern Psychology.*

By Wolfgang Köhler. Liveright Publishing Corporation, New York. \$2.49. viii + 369 pp. 1947.

No extended review is required of what is a mere reissue of an 18-year-old book published under the same title in 1929 by the same publisher. Prospective readers will want to know only whether there is anything new in it, especially in view of the publisher's blurb, which says "... completely rewritten and radically revised. . . ." The answer is, No. Except for a few footnotes, an occasional re-wording of a sentence, and a new title for an old chapter, nothing is new. Nevertheless, this remains a worthwhile book, being a capable and readable essay on the basic tenets of Gestalt psychology by its foremost exponent.

STANLEY B. WILLIAMS



SEX HABITS OF AMERICAN MEN. *A Symposium on the Kinsey Report.*

Edited by Albert Deutsch. Prentice-Hall, New York. \$3.00. xii + 244 pp. 1948.

Of the plethora of symposia on the Kinsey Report, this was earliest and clearly among the best. The editor with great skill assembled a varied and authoritative group of scientists and social thinkers to present their views. The poll reveals: Yea's, 9; Nay's, 0; Qualified votes, leaning to the favorable side, 4.

The affirmative opinions come from the editor Albert Deutsch (psychiatrist and writer); Robt. J. Havighurst (professor of education); J. K. Folsom (sociologist); Clyde Kluckhohn (anthropologist); Leo Crespi (psychologist); Morris Ploscowe (magistrate); Alice W. Field (probation officer); Abraham Stone (marriage counselor); L. I. Newman (Jewish rabbi); and Sidonie M. Gruenberg (Director, Child Study Association). The sketch by Deutsch of Kinsey's personal characteristics and his methods is very interesting. As to real critiques of the Report, Crespi has provided a penetrating analysis of the statistical methods employed by the Kinsey group, pointing out the unfairness of many of the charges made by critics who have failed to note, in the first place, that this is a progress report, and, even more significantly, have failed to distinguish between a *representative*, or random, sample, and an *experimental* sample that includes a statistically adequate sample of each distinct group in the population. The latter can readily be converted into the former by appropriate weighting of the values for each group; but the former can in no way be made to yield the latter. This, of course, explains why Kinsey selected the experimental sample. Crespi, in short, endorses the methodology of the Kinsey group wholeheartedly.

It is equally interesting, perhaps, to inspect the cases of qualified approval. These stem from R. P. Knight (psychiatrist), Seward Hiltner (Protestant minister), C. G. Wilber (Roman Catholic biologist), and Robert Lindner (clinical psychologist). Knight deplores the emphasis on means rather than medians or modes, and especially the use of accumulative incidences, which

magnify the importance of occasional practices rather than customary or habitual ones. He also dislikes the insistence on sexual outlet at the expense of emotional and other mental aspects of sex (but he fails to show how these can be measured, which is the crux of the matter); and he deplores the tendency to equate high frequency and normality. These have all been frequent criticisms of the Kinsey Report by others.

The Protestant and Roman Catholic both seem to accept what they like in the Report, and demur at what they don't like. Both are concerned that what *is* may be taken for what *ought to be*. The Roman Catholic questions the validity of the conclusions of the Kinsey Report for men of that faith, because of the small size of the sample. It is small, of course, and unquestionably Kinsey will try to enlarge it. But the real question is whether it is adequate, Kinsey having shown that the statistics of a sample of a particular group, uniform as to age, educational level, religion, etc., change little after the sample has reached a total of 300-400, except for the total range.

Lindner is critical mainly of the generalizations of the Kinsey Report about the sex-life of men in penal institutions. His opinion is that the special psychological atmosphere of a prison places "sex behavior beyond the range of the statistically predictable." In particular, phantasy is rife in such an atmosphere and is hardly distinguishable by Kinsey's methods from reality. This criticism seems more justified than most.

Most notable is the scope afforded by the Kinsey Report to these friends and critics to launch forth into a fresh consideration of their own fields of investigation or social activity. The crowning achievement of Kinsey's work is perhaps just this—that it has caused every person concerned with problems of sex behavior to take stock, and then to attack with renewed vigor and deeper understanding those problems before them.

BENTLEY GLASS



TELEPATHY AND MEDICAL PSYCHOLOGY.

By Jan Ehrenwald, with a foreword by Gardner Murphy. W. W. Norton and Company, New York. \$3.00. ii + 212 pp. 1948.

The subjects of telepathy and psychoanalysis are viewed by many experimental students of behavior with decided reservations, if not downright suspicion or derision. One anticipates with almost morbid relish the reaction that may be produced by the thorough admixture by Ehrenwald of these two highly controversial elements. Will these inflammable ingredients combine in an intellectual explosion, or will they compound an inert vapor that will be dissipated by the searchlight of objective scrutiny?

If the reader is willing for the sake of adventure (or on the basis of prior conviction) to accept Ehrenwald's

major premises, first, that telepathy is an established fact, and second, that the Freudian conception of personality dynamics is essentially valid, he may be rewarded by an intriguing set of postulates and deductions. Certain aspects of dreams, the nature and content of psychoanalytic procedure, the meaning of mediumistic phenomena, and the underlying mechanism of paranoia and schizophrenia are ingeniously interpreted in terms of extra-sensory thought transference. At the same time, by turning the insights of psychoanalysis to the problems of telepathy, an important source of evidence bearing on the latter acquires significance.

The unpredictable and capricious operation of the telepathic process, acting with little regard for time and space, and typically under minimal voluntary control, suggests that it is an evolutionary residue, for the most part supplanted by the more sharply discriminative, and thus biologically economical, sensory and cognitive processes. Its vivid demonstration in the dream state, under conditions of psychoanalytic rapport, in certain deficient children, in some emotional or neurotic states, and in more deviant pathological disorders, leads to the abstraction of three basic principles related to its occurrence. First, the successful agent or "sender" is characterized by partial or total repression, or by a pronounced emotional stress of certain thoughts, ideas, or complexes. Then, in the percipient there is some "minus-function" or deficit in the physiological or psychological sphere. Finally, there is a tendency to overcompensate for the deficiency by paranormal sensitivity to material from other minds. Sleep induces a transitory minus-function, and so at this time material is free to enter the dreamer's mind from the conscious, the pre-conscious, or the unconscious level of another person's mind. This material can be distorted by symbolization, condensation, and secondary elaboration by both agent and percipient, and is interwoven with items from the dreamer's own psyche and with reverberations of sensory stimulation. During receptive psychoanalytic sessions a more significant thought transference can take place, so that the analyst's interpretations often become the property of the analysand without vocal instruction, perhaps accounting for the alleged universality of a vocabulary of symbols. Similarly, the medium reveals presumably private information in the trance by telepathically tapping the sitter's conscious or unconscious. In some individuals the relevant minus-function is an intrinsic lack of rapport in inter-personal situations. At first this is compensated for by an oversensitivity to the unconscious or by repressed sadistic-aggressive tendencies of other persons; thus the paranoiac is not projecting his feelings to others, but is instead more acutely aware than his physician of the actual state of affairs in his social world! This condition may progressively deteriorate, so that the schizophrenic becomes sensitive, in

addition, to material from the preconscious minds of his fellows. His withdrawal from social contact is an attempted defence against these uncanny and threatening experiences. How the process can be neutralized or reversed by therapy is not yet clear.

Ehrenwald's manner while developing his hypothesis of heteropsychic influence has little of the combative dogmatism frequently displayed by advocates of psychoanalysis and extra-sensory research (or by their antagonists). Perhaps his casual modesty in describing an admittedly tentative system will forestall the resistance of rationalistic Freudians, of statistically inclined or spiritualistic mind readers, of skeptical traditionalists. Whether this theoretical framework represents more than a refreshing exercise in logic, the reader will have to decide for himself—if he can insulate himself against the telepathic polemics of the embattled protagonists.

FRANK W. FINGER



FUNDAMENTALS OF PSYCHIATRY. *Fourth Edition.*

By Edward A. Strecker. J. B. Lippincott Company, Philadelphia, London, and Montreal. \$4.00. xvi + 325 pp.; ill. 1947.

This is the fourth edition of a textbook designed for the use of medical students and practitioners. As with all of Strecker's books, it gives us a very clear presentation of psychiatry, its history, its usefulness in a general medical situation, and a clear description of the principal psychiatric syndromes, together with suggestions for treatment. The book is concise, it has an excellent glossary of terms, and may be recommended for the general medical group of biologists.

WENDELL MUNCIE



TWENTIETH CENTURY PSYCHIATRY. *Its Contribution to Man's Knowledge of Himself.*

By William A. White. W. W. Norton & Company, New York. \$2.50. 159 pp. 1947.

This is a reprint, under the same title, of the book which first appeared in 1936, based on White's Salmon Lectures. An introduction is followed by chapters on psychiatry as a medical specialty, or the social significance of psychiatry, and on the general implications of psychiatric thought. White's breadth of view and his very real ability to present psychiatry in an attractive form are amply in evidence in this book. At one point in his chapter on general implications, he takes a severe rap at "common sense as a method of procedure" and assumes that common sense is on the way out as a scientific method. This touches on the point of view which is dear to the teaching of Adolf Meyer, and as a pupil of the latter, I can only say that it seems to me that White and Meyer are really using the same term

to talk about different things or different aspects of the same thing. White talks as if common sense, that is to say, a consensus of opinion, must give way to research. Meyer never disputed this. He felt, however, that the results of research must always be finally measured along the present consensus, with the certain consequence that the exuberant claims of research would certainly be considerably toned down in the process. Meyer saw the products of research as something which must be integrated into the current common sense; and I think Meyer was right. We can see this process taking place in psychoanalysis; we see it also taking place in the physical sciences. Perhaps this is a minor item, but it serves to underscore the fundamental difference between White's and Meyer's approaches to psychiatric problems. White, as we know, was a devotee of the unusual, whereas Meyer was just as devoted to trying to increase the body of generally accepted fact. There would seem to be a place in all scientific thinking and practice for both points of view.

WENDELL MUNCIE



PSYCHIATRY FOR THE PEDIATRICIAN.

By Hale F. Shirley. *The Commonwealth Fund, New York; Geoffrey Cumberlege, Oxford University Press, London.* \$4.50. xii + 442 pp. 1948.

Here is a chatty volume for "the medical student and for the pediatrician and general practitioner who lack basic training in child psychiatry." By sticking wholeheartedly to his plan to make this a primer, uncomplicated by references to theories or controversies in the field, the author achieves a general effect of blandness. By inference it would seem as if various childhood problems have been thoroughly solved rather than being, as is actually true, in a constant state of flux as the psychodynamics of child development are increasingly understood.

In what is no doubt an effort to meet the average medical mind halfway, Shirley has indeed played down the more dynamic concepts of emotional development in favor of the out-dated psychobiological school of Meyer. He also refers frequently to Leo Kanner's views expressed some 10 years ago, when Kanner's book, now under extensive revision, was the classic text for child psychiatrists. It is my belief that even non-psychiatrically oriented doctors can be given really modern concepts of child psychiatry to challenge their thinking. If they have enough interest to pick up a volume with such a title as this, they deserve more real stimulation than Shirley has felt it wise to offer.

Still, this book is an attempt to fill a real gap in the training of pediatricians. Shirley covers a wide variety of topics, from the eating habits of children to the way to take an adequate social history of a patient—via such familiar landmarks as enuresis, sex, and sibling rivalry,

to name but a few. His style is discursive and occasionally painfully arch. However, he does survey the field with solid common sense and, until a more venturesome author tackles the problem, Shirley's book will be the best we have.

HELEN ARTHUR



PSYCHOTHERAPY IN CHILD GUIDANCE.

By Gordon Hamilton. Columbia University Press, New York. \$4.00. xxii + 340 pp. 1947.

Miss Hamilton has written a long and sometimes cumbersome defense of the social service worker as a child guidance therapist. She uses as her chief ammunition the success of the Jewish Board of Guardians of New York in allowing social workers, under trained psychotherapists, to take on disturbed children for treatment. In view of the impressive need for child guidance workers, it would be folly for even a purist to insist that social workers have a place solely in their own discipline and need not intrude into the psychiatrists' field. The author militantly denies that mere expediency should, however, influence one to accept her position. Social work, she thinks, should embrace all aspects of dealing with a disturbed child; and when specific treatment is indicated, the social worker can do it. Excellent case histories are given of children observed under therapy being conducted by social workers at the Jewish Board of Guardians' clinic. These case histories are the most interesting and persuasive part of the book and do much to win the admiration of a skeptical reader.

It is hard to know for whom this book is really intended. Without doubt different philosophies of social work will bandy it about, although the considerations presented are hardly new to them. However, to hand this book over to "teachers, clinical psychologists, and others," as the dust jacket suggests, seems a dangerous policy. These related workers may feel that if social workers can "cure" behavior problems, they can undertake such work, too. The Jewish Board of Guardians is unique in the careful psychiatric supervision of its social service child guidance staff. Less intelligently organized groups or individuals working on their own might make a considerable muddle if they attempted such a thing.

HELEN ARTHUR



BRIEF PSYCHOTHERAPY. *A Handbook for Physicians on the Clinical Aspects of Neuroses.*

By Bertrand S. Frohman, with the collaboration of Evelyn P. Frohman; Foreword by Walter C. Alvarez. Lea & Febiger, Philadelphia. \$4.00. 265 pp. 1948.

This book represents another attempt to present to the general medical public a brief and understandable

description of the treatment of psychiatric illness. It is possibly over-simplified, but a good general basic conception of the dynamics and treatment of neuroses can be obtained. An early section of the book is historical and explains simply the origins of the different schools which arose from the differences between Freud and his early followers. The main part of the book is devoted to the presentation of a brief method or "active analytic method" of therapy, and refers to such other kinds of treatment as electroconvulsive therapy, narco-synthesis, active psychotherapy, hypnotherapy, and various adjuvants of psychotherapy, advocating a combination of, or alternation between, these different methods of treatment as likely to shorten the necessary duration of a treatment. As the book appears to be written for the use of people who are unlikely to give such treatments, all this hardly seems necessary. The book is simply and clearly written, and includes a considerable glossary, as an appendix tactfully entitled "glossary for patients." The index is well prepared and likely to be of use.

DAVID ROSS



PSYCHIATRY IN NURSING.

By Raymond Headlee and Bonnie Wells Corey. Rinehart & Company, New York. \$3.50. xii + 308 pp. 1948.

This handbook of nursing raises the question of the primary objective of such a book. It seems to attempt to combine a textbook of psychiatry for nurses with a section (Part III), on Psychiatric Nursing. In this the authors appear to fall between two stools. The latter subject is not covered extensively or thoroughly enough, although it gives many valuable suggestions regarding the nurses' understanding of and approach to mental illness. There is also some quite valuable psychiatric material bearing on the nurse's own psychological state.

A chapter on Study Hints, Appendix A, probably quite a new feature in such a book, is of itself an admirable attempt; but to be adequate it would have to be almost a small handbook in itself—condensation has made it rather indigestible for one who is not already familiar with the concepts listed. The chapters on Sleep, Pain, and Sexual Adjustment are also quite new. They are logically and reasonably treated. In general, the book presents a mixture of exceedingly simple and rather complex treatment of three aspects of one subject. Somehow it manages to be a useful book in the end.

DAVID ROSS



THE PSYCHIATRIC STUDY OF JESUS. *Exposition and Criticism.*

By Albert Schweitzer; Translated and With an Introduction by Charles R. Joy; Foreword by Winifred Overholser. The Beacon Press, Boston. \$2.00. 81 pp. 1948.

The Psychiatric Study of Jesus was written in 1913. Albert Schweitzer was then already a doctor of philosophy, a doctor of divinity, and a renowned organist, a famed interpreter of the music of Bach. He had, furthermore, finished his medical studies. This book was his thesis for the degree of doctor of medicine.

Four writers, German, French, American, and Danish, respectively, had won considerable notoriety at the time by writing books in which they advanced the theory that Jesus of Nazareth was a psychopathic type—more specifically, a sufferer from paranoia. Schweitzer's thesis is a refutation of such views, in the light of the best medical knowledge of his time. His arguments are very powerful and illuminating.

He insists, in the first place, that anyone who makes such claims must base them on the facts of the case history. Apart from the unreliability of historical facts in general, this means that in analysing the mental state of Jesus, we must limit ourselves to those parts of the gospels accepted by scholarship as historical. This clearly rules out the gospel of John, from which most of the supposed evidence of paranoia had been cited. Secondly, Schweitzer points out that no man lives in a vacuum. The common beliefs of the people of Jesus' generation, race, and religion—in particular, beliefs in the imminent advent of the Messiah, the coming of the Kingdom on earth, and the angels—can in no way be regarded as symptoms of mental aberration in him. Again, the occurrence of hallucinations is not confined to the mentally ill. Jesus' failure to develop a persecution complex and his complete change of view as to his own mission—from that of the earthly Messiah to the One who had to die for his followers—these are also held to be incompatible with paranoia. As to the two last points, modern medical opinion may differ with Schweitzer, but the other reasons are as cogent as ever. Schweitzer completely and finally demolished the theory of a paranoid Jesus.

This is a medical thesis, as we have said, but it is a medical book such as only a man who was also both trained historian and devout theologian could have completed. It is a monument to the many-sided genius of one of the truly great men of this century. English-speaking people throughout the world will be grateful for this translation.

BENTLEY GLASS



THE YEARBOOK OF PSYCHOANALYSIS. Volume 3. 1947.

Edited by Sandoz Lorand. International Universities Press, New York. \$7.50. 309 pp. 1948.

In this third volume of the *Yearbook*, the editors have

selected twenty contributions, by almost as many authors, to represent the high marks of the psychoanalytic literature of the year. It is not possible to give an evaluation of all these articles here. They cover a wide range of subjects from the history of psychoanalysis and research problems, if by the latter we may include speculative interpretations, to treatment procedures and that favorite of psychoanalytic literature, the mythology and folk lore of peoples.

Of the several contributions the following may be singled out for special mention: An Unknown Autobiographical Fragment by Freud (Siegfried Bernfeld); A Valedictory Address (Ernest Jones); Notes on Development in the Theory and Practice of Psychoanalytical Technique (Payne); The Anti-Semitic Personality (Brunswick and Sanford); and Constant Elements in Psychotherapy (Oberndorf). This last-named contribution I believe will rank with Kraepelin's *Manifestations in Insanity* (1921) as a mile stone in psychiatry for its willingness to abandon a parochial viewpoint. For a reasoned and reasonable approach to treatment remarkably free of dogmatic bias, one would look in vain elsewhere in the psychoanalytic literature for anything to approach Oberndorf's statement, so far as I am aware. This kind of statement can only be made by a person of vast experience, a broad grasp of the functioning of personality as opposed to dogmatic conceptions of it, and an essential sort of honesty and humility in approaching the psychiatrist's task. In selecting these few statements for special mention, it is not implied that the other contributions suffer by comparison. The volume is remarkably stimulating and provocative.

WENDELL MUNCIE



PSYCHOANALYSIS AND THE SOCIAL SCIENCES. *An Annual*; Volume 1.

Edited by Geza Róheim. International Universities Press, New York. \$7.50. 427 pp. 1947.

According to the editor's foreword, this annual presents the psychoanalytic point of view for all subjects from anthropology to sociology. The book is accordingly subdivided into parts dealing with anthropology, mythology, religion, literature, history, and sociology. The editor stresses that while this is an exclusively psychoanalytic publication, in the strict Freudian sense, factual contributions on subjects of interest to the psychoanalyst are welcome. This first volume is therefore, it would seem, a mixture of factual material, with little direct psychoanalytic interpretation, and exclusively psychoanalytic material, in some cases with little factual background.

In a very interesting introduction entitled *Psychoanalysis and Anthropology*, the editor discusses the convergencies and divergencies of the two disciplines. This becomes a eulogism on *Totem and Taboo*, and

strikes the note for the more strictly psychoanalytic contributions which follow, for they too might all be lumped as reworking the primal horde theme of "Totem and Taboo."

Considering that the editor has stated that factual material of interest to psychoanalysts would be accepted, considerable cold water is thrown on his offer by the last paragraph of his introduction, in which he says: "It is true that anthropologists for the most part still use psychoanalytic terms without understanding their meaning. . . . Nobody can really understand what it is all about without having been analyzed. Few would go with me so far, yet I will go a step further. If we are really to understand psychoanalytic anthropology in the Freudian sense, it will have to be written by those who have not only been analyzed but actually practiced analysis themselves. Without this practice, nobody can acquire real skill in deep interpretation, and without constant contact with the unconscious we are likely to repress the results of our own analysis and resistance will gradually get the upper hand." As for understanding the data of folk lore or of anthropology or sociology, "... a complete therapeutic analysis of a primitive is by far the best. Only an analyst who lives in the country can do that. . . . The next best to this is what the field anthropologist can do if psychoanalytically trained." In a foot note, Róheim goes so far as to say: "If lay analysts are not going to be trained, psychoanalytic anthropology should be in the hands of M.D.'s who are also anthropologists." In other words, Róheim stands virtually alone as eligible to understand anthropology from the psychoanalytic standpoint.

There are contributions by Kluckhohn, Róheim, and Spitzer concerning anthropology; by Bunker on mythology; by Bunker, Feldman, Hirschmann and Lorand on religion; by Bergler and Oberndorf on literature; by Loewenstein on history; by Hartmann, Kris and Leites, and Sterba on sociology.

To the reviewer, who is not an analyst but is interested in all of these issues, these contributions seem of quite variable value. Kluckhohn's article is exceedingly factual and does not go very far afield in deriving dynamic interpretations. Bunker's two articles and Feldman's are quite interesting, particularly the last, as again offering factual matter. Oberndorf discusses Nathaniel Hawthorne and indicates that Hawthorne's insight, as expressed in his creative products, had little or no therapeutic effect on his own difficulties. Hartmann's article, On Rational and Irrational Action, appears longwinded and really offers nothing new about personality structure and functioning. Kris and Leites, writing on Trends in Twentieth Century Propaganda, are exceedingly interesting when they compare propaganda in World War II with that in World War I. Sterb's article on Some Psychological Factors in Negro Race Hatred and in Anti-Negro Riots I find most disturbing. Using as material the Detroit riot of a year or so ago, Sterba makes astonishing analogies with

psychoanalytic interpretations which seem only humorous. For instance, when Negro race riots are regarded as essentially identical with fox hunting, and then the fox is identified without further ado as a penis, simply because he runs into a hole in the ground, what can one say?

The purpose of such an Annual as this would be better served, it seems, if it were under the direction of a less biased Freudian. The correlations—between the unconscious—as expressed in dream analysis, etc., and in neurosis and primitive culture must remain essentially a serious topic but scarcely one to be handled best by people who already are convinced they know the answers. A critical reader will find much of interest and value in this volume, and I for one shall continue to read it, seriously in spots, with amusement in others, being one of the great unwashed who can't possibly understand the full implications of some of the gems cast before us. Yes, such a volume is exceedingly interesting.

WENDELL MUNCIE



THE PSYCHO-ANALYTICAL APPROACH TO JUVENILE DELINQUENCY. *Theory: Case-Studies: Treatment.*

By Kate Friedlander. *International Universities Press, New York.* \$5.50. viii + 296 pp. 1947.

Kate Friedlander has written an excellent book on the psychodynamics of juvenile delinquency. Studying various types of delinquents from the psychoanalytic point of view, she has been able to draw conclusions not only about the reasons why individuals are delinquent but also as to how a delinquent must be treated if he is to be reclaimed by society.

Part I is devoted to a very lucid explanation of how social adaptation normally takes place during emotional development. Part II gives descriptions of what happens when social adaptation fails to take place. The antisocial character, the common offender, the neurotic delinquent, and the sex delinquent are discussed in the perspective of their emotional development. Part III deals in a realistic and forthright manner with the treatment of juvenile delinquents. This might have been a very bitter discussion, for our penal workers, judges, probation officers, and our very laws are far removed in most cases from accepting (or understanding) a truly rehabilitative approach to the individual delinquent. The author, however, points without recrimination to the route we must follow if our young offenders are to get constructive handling. She stresses the need for diagnosing each delinquent's personality and then for an intelligent use of psychotherapy or environmental readjustment. Some offenders can benefit from psychoanalysis, some can respond to special training schools, and some will be responsive to a trained parole officer or to a social service placement. It will take money to effect a change in our treatment

of the juvenile delinquent, yet no more than we now spend in the almost completely futile effort to lock every young offender up.

Every adult who works with children should read this book. The word "psychoanalysis" in the title does not indicate a theory but rather a method of investigation. Friedlander has a real talent for expressing psychodynamic material in clear, practical terms. Only by comprehending the meaning of antisocial activity in the juvenile delinquent can sincere, thoughtful men and women become more positive forces for dealing with the growing problem of young criminals.

HELEN ARTHUR



HUMAN BIOLOGY

FIJIAN VILLAGE.

By Buell Quain, With an Introduction by Ruth Benedict. *The University of Chicago Press, Chicago.* \$5.00. xviii + 459 pp. + 24 plates + 2 maps; text ill. 1948.

In 1935-36 Buell Quain, who unfortunately died on a field trip in Brazil in 1939 at the age of 27, spent a year in an inland village, Nakoraka, on one of the Fiji islands, Vanua Levu. There he studied intensively all aspects of life (livelihood, life cycle, kinship, etc.) in this primitive village, where the existence of a nobility, based on general ancestor worship, was the most significant feature. A most interesting introductory study of Fijian history by the author reveals that many traits in this obviously old and genuinely primitive culture were imported only a hundred years ago by Tongan invaders, who had been armed by Wesleyan missionaries. Quain thus explains the inconsistencies and uncertainties in the cultural ideals and social organization of these Fijians by the relatively recent grafting of Tonga culture on an older and different Fijian culture. The author's early death is the more to be regretted because his monograph, covering a very little-known and by now probably thoroughly "acculturated" area, is such an excellent piece of work. He strikes the right balance between concrete reporting and conceptual abstractions, avoiding equally well diffuse gossip and arid generalization.

ERWIN H. ACKERKNECHT



THE COWRIE SHELL MIAO OF KWEICHOW. *Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University, Volume XXXII, Number 1.*

By Margaret Portia Mickey. *Peabody Museum of American Archaeology and Ethnology, Harvard University, Cambridge.* \$2.50 (paper). x + 83 pp. + 8 plates; text ill. 1947.

In the southern provinces of China live millions of

so-called "aborigines," agriculturists who differ from the Chinese in speech and dress though in little else that is obvious. Margaret Mickey has lived in a village of one of these groups, and has recorded their simple peasant life with its agricultural and home activities, feasts, ceremonies in the event of sickness or death, etc. As almost nothing is known concerning these "aboriginal" groups, this monograph, although strictly descriptive and none too complete, is a welcome addition to ethnographic literature.

ERWIN H. ACKERKNECHT



THE WHALE HUNTERS OF TIGARA. *Anthropological Papers of The American Museum of Natural History, Volume 41: Part 2.*

By Froelich G. Rainey. *The American Museum of Natural History, New York.* 70 cents (paper). Pp. 227-284. 1947.

A cultural study of an Alaskan Eskimo village of whale hunters. The main sections deal with the Social Structure of Tigara Village in the Nineteenth Century, the Native Economy and the Yearly Cycle before 1900, and Native Theory, i.e., tales of origin, the supernatural, and the roles of shamans.



MARÍA: THE POTTER OF SAN ILDEFONSO.

By Alice Marriott; with drawings by Margaret Lefranc. *University of Oklahoma Press, Norman.* \$3.75. xxi + 294 pp.; ill. 1948.

Some time ago this reviewer suggested that the variations upon which natural selection acts might more likely be physiological than morphological, and that therefore evolution might occur in populations in which there was little or no morphological differentiation. The late William E. Ritter, in commenting on that theory, pointed out that since there is no difference between the hands of those Indians who weave blankets and of those who make pottery, and that since each pueblo is characterized by its own peculiar type of pottery, a situation that might reasonably be interpreted as being one of so many instances of physiological differentiation, the pueblo Indian populations might possibly afford an instance of physiological evolution in actual process. It seems appropriate therefore, that the biography of the best known potter of the pueblos should be reviewed in a periodical devoted to the biological sciences.

This work is not a complete biography, however, as the author states in her Foreword. There are many things of a religious, a political, or even of a personal nature which common courtesy requires shall not be divulged, and the experience of Indians with Caucasian honor has impressed upon them the inadvisability of

being too confidential with a paleface. So qualified, this is the narrative of life in a pueblo which, since its original independence, has been under the governments of New Spain, the Republic of Mexico, and the United States. The story covers six generations, for María, who now has grandchildren of her own, can remember her own great-grandmother. Indeed, the account, which tells how that magnificent old lady, her mind clear and vigorous to the end despite her emaciated and bed-ridden body, called her descendants together on the eve of her departure to distribute her earthly belongings among them, is a remarkable story of simple impressiveness and singular beauty. All the other chapters in the book are stories also beautifully told—the children playing with their dolls, the pilgrimage to Chimayo, the self-flagellation of the Penitentes, school days in Santa Fé, María's marriage to Julián, the birth of their first child and its subsequent death of fever, Julián's accidental discovery of the secret of making matte black pottery, the intrusion of the liquor traffic into the pueblo despite the efforts of the Indians themselves to suppress it, and Julián's death from over-indulgence in alcohol—these are vivid word pictures of life in the pueblo viejo.

Today the Pueblo of San Ildefonso is bypassed by a modern highway that leads from the City of the Holy Faith to the City of Destruction. María can hear the detonations of atomic energy, but, like her own residence which turns its back upon the highway, she ignores them and continues to make her pottery, which tells the story of a culture already ancient when Marcos de Niza searched for the Seven Cities of Cibola, of a culture whose history extends backward through forgotten centuries when generation after generation of Indians were begotten and gathered to their fathers, of Indians whose brief life span was spent in fighting off nomadic marauders, cultivating corn, constructing irrigation canals, and praying for rain. Perhaps, when the Gringos at Los Alamos have blown themselves to oblivion with their atomic bombs, there will still be Indians at San Ildefonso, tending their fires of sheep dung, and making matte black pottery. "Arise, and go down into the house of the potter, and there will I cause thee to hear my words."



THE NUBA. *An Anthropological Study of the Hill Tribes in Kordofan.*

By S. F. Nadel, with a foreword by Hubert Huddleston. Oxford University Press, London, New York, and Toronto. \$11.00. xiv + 527 pp. + 25 plates + 1 map; text ill. 1947.

Although this anthropological study of the hill tribes of Kordofan, a part of the Anglo-Egyptian Sudan, was planned to be primarily of practical value to administrators and others interested in the particular geo-

graphical area concerned, it constitutes an interesting account of life in an area which has hitherto escaped thorough investigation by the rest of the world. Until 1926 the primitive pagan tribes inhabiting the Nuba hills were still held in check by military patrols; consequently, little was known of their customs, beliefs, or mode of life. The present volume, representing an intensive three-year study, is admirable in its detail and scope. It discusses the economic and social life of all the chief tribes. Among the topics touched upon are: agricultural techniques, tribal codes, chieftainship, hunting, political systems, adolescence, marriage, settlement and homestead, wealth, properties, industries, and Arab influence. The illustrations, though only fair from a photographic point of view, are very good as to subject. They show the nature of the country, the characteristics of the inhabitants, their dwellings, and their industries. While a student interested in this particular subject would not hesitate to procure this volume, the price may well dissuade more casually interested readers.

V. G. DETHIER



THE NEGRO FAMILY IN THE UNITED STATES. *Revised and Abridged Edition.*

By E. Franklin Frazier. The Dryden Press, New York. \$3.75. xviii + 374 pp. 1948.

To reprint this classic on the negro family that first appeared in 1939, now brought up to date and given a form that makes it accessible to a larger public (through the elimination of appendices, statistical tables, and comprehensive bibliography), is a service of real merit. In a masterful way Frazier has described and analysed the present-day forms of the negro family: the rural and city "matriarchal" type, the old and new patriarchal types, and the different forms of decomposition families, as they have developed out of the subhuman situation of slavery, the shock of "liberation," the feudalism of the rural South, and the disorganizing and organizing influences of the Northern Big City. The solid factual foundation and objective scientific attitude of the book do not exclude the author's deep psychological understanding and human sympathy with the objects of the study. In many ways these developments of the negro family parallel the development of immigrant groups. That a sensitive white will often have to blush for his own group in reading this useful book is not the author's fault.

ERWIN H. ACKERKNECHT



ANTHROPOLOGIE DE LA POPULATION FRANÇAISE.

By Henri V. Vallois. Didier, Paris. 50 cents (paper). 132 pp. + 4 plates; text ill. 1943.

This is a very competent, though brief and semi-popular account of what has become known regarding the physical-anthropologic conditions prevailing in France. Henri Vallois, the foremost anthropological authority in France, frankly admits, and even emphasizes, that so far one can merely sketch a tentative outline of the historical and regional, racial composition of the French population, which differs only quantitatively, not qualitatively, from the peoples of the other nations of western Europe. Together with their interrelations, the usual, statistically adequate data on stature, length-width proportion of head and of nose, hair color, blood groups are briefly discussed, and very little else. In his analysis and guarded conclusions the author bravely adheres to the sound, old, and recently widely and violently attacked definition of race as "un groupe d'hommes présentant un ensemble de caractères physiques héréditaires communs. Les caractères de civilisation ou de langage n'ont rien à faire avec la race."

The detailed, yet limited, conclusions in regard to French racial history and distribution contain nothing that is new in the literature. The booklet ends with this charge and appeal: "... nos données sur les races humaines de la France sont beaucoup moins étendues que celles que peuvent avoir les zoologistes ou les botanistes sur les races animales ou végétales de notre sol. Une telle ignorance devrait cesser."

A. H. SCHULTZ



POSTWAR GERMANS. *An Anthropologist's Account.*

By David Rodnick. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. \$3.75. xii + 233 pp. 1948.

It is a pity that not all chapters of this book resemble chapters 12 to 15, which are honest and colorful reporting upon the opinions of three social-democratic militants, five members of the upper classes, and the party life of the Right and Left in the eastern part of Hesse in the American zone of occupation in Germany. The rest of the book unfortunately pretends to inform us about "the postwar Germans." The author bases his analysis on a five-month stay in a part of rural Hesse of a very particular character. During this time he interviewed 151 persons, had 278 questionnaires filled out by boys and girls from 12 to 19 years of age, obtained essays from 125 boys and girls between 10 and 20, and "observed" altogether 1500 Germans. The result of these profound studies are, as one would suspect, startling, or, to anybody who knows Germany, rather funny. We learn, for example, that "the mother more than the father is looked upon as the symbol of authority"; that "religion in Germany is largely fundamentalist," and "the churchgoing habit is strong in almost all classes"; that "German children, unlike many American children, have no hostile reactions to schools as such" and that "German children feel an obligation to 'love' their teachers"; that "the communist

youth are the least anti-Allied in sentiment of any of the young people of Germany"; that "German villages are picturesque when viewed from afar, but the half-timbered dwellings are crowded together flush to the street with no lawns, and the small courtyards are filled with barns, sheds, pig pens, and manure piles." A particularly good joke is Rodnick's singlehanded "Kinsey" report on the sex life of young Germans.

In view of these "solid foundations" of Rodnick's book, one hesitates to follow him even when one feels he has hit upon something, as in his analyses of class structure, postwar changes in women's mentality, or political attitudes of the "lost generation." Once again the only thing that possesses lasting value is the body of original quotations from the youths' essays.

It is characteristic that many passages of this book on "Germans" are almost identical with a number in such books as those of Gorer and Mead on "Americans," which I have previously reviewed in this journal. The only explanation seems to be that these authors, somehow indoctrinated by psychoanalytic theory, project the same figments of imagination into their subjects; and that in addition they all seem in varying degrees unable to differentiate between specific national and specific class ideologies, although the latter are similar throughout different nations, or to differentiate either from general human attitudes. This new "social science" of "national characters" is about as scientific as the attempt to split atoms with a junior chemistry set.

ERWIN H. ACKERKNECHT



SOCIETAL EVOLUTION. *A Study of the Evolutionary Basis of the Science of Society. Revised Edition.*

By Albert Galloway Keller. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. \$3.75. x + 419 pp. 1947.

Seventeen years after the second edition was first printed, and 33 years after its original publication, this book is reprinted as a sociological classic under the auspices of the William Graham Sumner Club. The author's thesis is that the Darwinian scheme may be applied to human society with more than the force of an analogy. In a real sense, he avers, variation, selection and counterselection, transmission, and adaptation occur on the social level. Students of evolution, if unacquainted with Keller, should remedy this deficiency. *Societal Evolution* is an interesting supplement to the symposium on *Levels of Integration in Biological and Social Systems*.

BENTLEY GLASS



INTELLIGENCE AND FERTILITY: *The Effect of the Differential Birthrate on Inborn Mental Characteristics. Occasional Papers on Eugenics, Number Two.*

By Cyril Burt. *The Eugenics Society and Hamish Hamilton Medical Books, London.* 2s. (paper). 43 pp. [1946] 1947.

The major question in eugenics is perhaps the question whether the level of intelligence in our present populations is, or is not, sinking because of lowered fertility in the higher income groups. For some thirty-five years the eminent author of this booklet has worked to secure a valid answer to the question, at least for the population of Great Britain. This slender paper-covered pamphlet, so inexpensive in terms of money, so priceless in terms of labor spent and knowledge gained, is his summary of what he and others have learned. Not least valuable is the appraisal, in an Appendix, of the meaning of intelligence.

The conclusions are these: (1) In Britain, there is a small but significant negative correlation, of about -0.20 , between intelligence and size of family. (2) This negative correlation is enough to bring about a drop of $1.5-2.0$ I. Q. points in the general level of intelligence in the population per generation. (3) The drop is faster in rural than in urban districts. (4) The reduction in intelligence is more important at the extremes of the frequency distribution than in the middle. For example, the decline is reducing the proportion of children of "scholarship grade" (I. Q. > 130) by one-half in little over 50 years, and in the same term is almost doubling the number of feeble-minded (I. Q. < 70). This situation, which is probably equally grave in the United States, calls for a maximum effort to preserve our human resources.

There are, to be sure, many sources of error in the measures and calculations which lead to these conclusions. One bias, which can never be overcome, is produced by the general alteration in the social environment, which takes place from day to day. The reader of Sir Cyril Burt's dispassionate survey will, however, come unavoidably to a recognition that every possible precaution to reach a valid and reliable answer has been taken, and that the sources of error have been fully acknowledged and critically appraised.

The pamphlet, of course, only reveals the existence of a crucial problem. No solutions are suggested—that is work for the future, for the present and oncoming generations of students of human heredity and social relations to undertake.

BENTLEY GLASS



POPULATION ANALYSIS. *McGraw-Hill Publications in Sociology.*

By T. Lynn Smith. *McGraw-Hill Book Company, New York, Toronto, and London.* \$4.50. xiv + 421 pp. + 1 map; text ill. 1948.

There is a great need for an up-to-date and comprehensive textbook of population analysis. One might have hoped that Smith's book would satisfy this need,

but unfortunately such is not the case. In the first place the book is not up to date. Indeed, the greater part of the volume could have been—and perhaps was—written during the later years of the War. The more recent publications of the Census Bureau (including parts of the 1940 census) have not been used, nor has the author mentioned important projects in the field of population research which have been going on for several years. The presentation of world-wide data is largely limited to the reproduction of several tables from the *Statistical Yearbook* of the League of Nations, in some instances carried out so mechanically that countries still appear in the order of alphabetic listing in French, like the original publication.

Population Analysis is planned along conventional lines. In 21 chapters the author discusses the size and distribution of population, its composition, the vital processes, migration, and population growth. The handling of the Material, however, is very uneven. In some chapters a wealth of detail is presented, whereas other subjects are treated very briefly. Although Smith stresses the importance of acquainting the student with methodology, no reference to such widely used concepts as indirect standardization, the gross reproduction rate, the intrinsic rate of growth, the nuptiality table, and the logistic curve can be found. Census tracts, sampling procedures, the net reproduction rate, and population projections are mentioned but not discussed adequately. In addition to these omissions several positive errors have been made. The most serious of these appears in a rather elaborate chapter on immigration to the United States, where the discussion leaves the reader under the impression that the annual quotas still amount to two per cent of the foreign-born enumerated in 1890. Actually, from 1929 on, the quotas have been based upon the (estimated) national origin of the total white population in 1920. The book is well printed and illustrated with a profusion of charts and maps.

CHRISTOPHER TIETZE



BIOMETRY

INTRODUCTION TO MATHEMATICAL STATISTICS. *Wiley Mathematical Statistics Series.*

By Paul G. Hoel. *John Wiley & Sons, New York; Chapman & Hall, London.* \$3.50. x + 258 pp. 1947.

In recent years a large number of introductory statistical textbooks has appeared. Nearly all of them have been directed toward students in specific fields of application, such as biology, economics, psychology, and so forth, and have oriented the presentation to the use of the methods rather than to their mathematical bases. On the other hand, there has been a real scarcity of introductory textbooks dealing with the mathematics of statistical methods. Hoel's book meets a very real need and meets it exceedingly well.

The book forms an excellent companion to a competent subject-matter textbook such as, for example, Hill's *Principles of Medical Statistics*. It assumes a knowledge of elementary calculus, but theory requiring more advanced training than that for its derivation is presented without proof. The biologist with a limited amount of mathematics at his command will not find this a formidable book, and will be helped by the liberal use of illustrative examples from biological and other fields. The fact that the book developed out of Hoel's experience in presenting the subject to science majors, and that he wrote with an awareness of the needs of applied statisticians has made this a singularly successful presentation for the scientist.

The author of any such treatise is faced with a very difficult problem in the selection of material. Here again one is impressed with the skill shown in planning the book. A good balance between classical large sample theory and small sample theory has been achieved. Recent developments in such topics as sequential analysis, discriminant functions, non-parametric methods, and the testing of hypotheses are introduced. References to more extensive treatments of these subjects are given, and a brief comment on what the reader may expect to find in these references is frequently included. Exercises at the end of each chapter add to the appeal of the book, both for undergraduate teachers and for the many scientists who try to get an understanding of statistical theory through their own study. For such students, it should be recognized that this book is not a substitute for a subject-matter textbook that gives thorough consideration to the problems inherent in the collection of data, the types of errors likely to be encountered, and interpretations relevant to a particular field. Thus scant attention has been given to the labeling of axes in terms of the data presented, or in attaching units to arithmetic results; and only superficial interpretations are attempted. The arithmetic examples serve their purpose, however, in making the mathematics more easily read and understood. The book can be heartily recommended to the growing group of biologists who are thinking in quantitative terms.

MARGARET MERRELL



FUNDAMENTALS OF STATISTICS.

By Truman Lee Kelley. Harvard University Press, Cambridge; Geoffrey Cumberlege, Oxford University Press, London. \$10.00. xvi + 755 pp.; ill. 1947. According to the author's preface, "An alternative title for this book which would emphasize the point of view is *Statistics, Its Philosophy and Method*. . . The endeavor herein has been to place a great emphasis upon the logic and principles underlying the statistical study of phenomena, to provide, in the early chapters, such basic issues as will integrate thoughtful and investi-

gative moods with statistical processes, and, in the later chapters, to give such treatment of modern processes as is required in handling many experimental situations and as will open to the reader the wealth of thought in current statistical literature. The early chapters constitute an elementary text. . . ."

As an elementary text, this will very likely be difficult for most students. The author's style of writing, a sample of which appears above, is often long and involved. One can also find occasional "orphan" sentences which appear completely out of context, as though the author had jotted down a random thought from time to time. There are, furthermore, many errors in the equations and text. These are, to be sure, minor errors for the most part, but they will greatly handicap the student. Finally, although the author claims to have emphasized the logic and principle underlying statistical procedures, he very often presents statistical concepts with no more explanation than one gets from the most dogmatic writers in this field.

Even the advanced student of statistics or the experimentalist will find this a spotty text. It treats some statistics—biserial r , point biserial r , and moments, for example—much more comprehensively than do most other texts. The reviewer, in fact, had certain long-standing queries cleared up here for the first time. Especially noteworthy is the final chapter, which deals with matrices, determinants, hypergeometric series, factorials, and other mathematical functions valuable in advanced statistical work. But then other equally important statistical techniques—curve fitting to experimental data and the analysis of variance—are completely ignored.

On the whole, this should be most valuable as a supplementary textbook because, despite its gaps, it contains many important, special formulae which are difficult to find elsewhere and because it treats many statistical techniques more intensively than probably any other comparable text. The examples and illustrations, incidentally, are well adapted for workers in the biological sciences.

A. CHAPANIS



GRUNDBEGRIFFE DER WAHRSCHEINLICHKEITSRECHNUNG. *Ergebnisse der Mathematik und ihrer Grenzgebiete. Volume Two.*

By A. Kolmogoroff. Chelsea Publishing Company, New York. \$2.25 (paper). vi + 62 pp. 1946.

This is a reprint of a book written in 1933. It presents a certain probability theory as a mathematical discipline. Thus the subject proceeds from carefully stated axioms and definitions to the theorems that follow from them. The book is directed to students of probability and other mathematicians and cannot be read easily by others. For the biologist, it may be a satisfaction to know that such a book exists, since this type of mathe-

mathematical output has been productive of theory which the biologist has in the past found useful.

MARGARET MERRELL



THE THEORY OF MATRICES. *Ergebnisse der Mathematik und ihrer Grenzgebiete: Herausgegeben von der Schriftleitung des "Zentralblatt für Mathematik,"* Zweiter Band. Corrected Reprint of First Edition.

By C. C. MacDuffee. Chelsea Publishing Company, New York. \$2.50. vi + 110 pp. 1946.

This is a valuable survey of matrix theory, written for the pure mathematician. It is assumed, for example, that the reader knows what is meant by field, ring, abelian group, and divisor of zero (to take instances from the first three pages). The practising biometrician will find it heavy going.

C. P. WINSOR



CALCULUS OF FINITE DIFFERENCES. *Second Edition.*

By Charles Jordan; introduction by Harry C. Carver. Chelsea Publishing Company, New York. \$5.50. xxii + 652 pp. 1947.

This is a second edition of a textbook which Carver, in his Introduction, says "is destined to remain the classic treatment for many years to come." The text is sufficiently detailed to make little demand on the reader's mathematical education. The author has borne in mind the practical needs of the computer. His remarks on the construction and use of tables (§132 ff.) should be better known.

CHARLES P. WINSOR



DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

SCIENCE NEWS 7.

Penguin Books, Harmondsworth, Middlesex. 1s. 6d. (paper). 128 pp. + 16 plates. 1948.

Among the eight articles in this issue of *Science News* there are two upon biological topics: Hearing of Insects (Gabriele Rabel); Anti-Vitamins (John Yudkin). There are also brief discussions (Research Notes) on the heart in starvation, the relation of climate to food, control of the tsetse fly, investigations of midges, and the use of radio-tracers in the study of embryonic processes and nutrition.

These booklets continue to maintain their high original standard of simple writing combined with authoritative exposition. It is a great misfortune that they are so hard to secure here in the United States.

NEWTON TERCENTENARY CELEBRATIONS, 15-19 July 1946.

The Royal Society. Cambridge, at the University Press. \$3.00. xvi + 92 pp. + 6 plates; text ill. 1947.

This handsome volume collects the lectures and addresses to the 119 delegates of 35 nations, given at the Newton Tercentenary Celebration, held under the auspices of the Royal Society at Cambridge. These include: Newton (E. U. da C. Andrade); Newton, the Man (Lord Keynes); Newton and the Infinitesimal Calculus (J. Hadamard); Newton and the Atomic Theory (S. I. Vavilov); Newton's Principles and Modern Atomic Mechanics (N. Bohr); Newton: the Algebraist and Geometer (H. W. Turnbull); Newton's Contributions to Observational Astronomy (W. Adams); Newton and Fluid Mechanics (J. C. Hunsaker). Three portraits of Newton and pictures of his rooms at Trinity College, his home at Woolthorpe Manor, and a reproduction of a letter from Newton to Halley embellish the book.



CHYMIA. *Annual Studies in the History of Chemistry. Edgar F. Smith Memorial Collection: University of Pennsylvania. Volume I.*

Edited by Tenney L. Davis. University of Pennsylvania Press, Philadelphia; Geoffrey Cumberlege, Oxford University Press, London. \$3.50. xiv + 190 pp. + 16 plates; text ill. 1948.

So handsome a book of essays in the history of chemistry as the one at hand will, it is to be hoped, encourage biologists to prepare the like. While the particular essays included in this first volume of a new series deal with subjects of rather indirect interest to biologists, they form a fitting memorial to C. A. Browne, whose last paper, one on the chemist Frederick Accum, stands at the beginning of the contents. The Edgar F. Smith Memorial Collection of the University of Pennsylvania deserves congratulations on so worthy an undertaking and so excellent a beginning.



THE AMERICAN COLLEGE DICTIONARY. *Text Edition.*

Edited by Clarence L. Barnhart, with the assistance of 355 authorities and specialists. Harper and Brothers, New York. \$5.00 (\$6.00 with thumb index). xi + 1432 pp.; ill. 1948.

This is "the first general desk dictionary to be prepared by a staff of experts as large as that usually assembled for an unabridged dictionary." The basic list of words was provided by Lorge and Thorndike's *Teacher's Word Book of 30,000 Words*. This was supplemented by the specialists in various fields and by the use of glossaries

and special lists of several sorts. There is a single alphabetical listing of all entries, including proper names. The various meanings of a word are arranged in order of common usage. There are prefaces on Selection of Entries and Definitions (Irving Lorge); Pronunciation (W. Cabell Greet); Treatment of Etymologies (Kemp Malone); Synonyms and Antonyms (Miles L. Hanley); Usage Levels and Dialect Distribution (Chas. C. Fries); British and American Usage (Allen W. Read). Also included are A Handbook of Punctuation and Mechanics, A Guide to Letter Writing, Manuscript and Proof, Proofreader's Marks, Signs and Symbols, Table of Common English Spellings, Colleges and Universities in the United States, etc.

The authorities include 19 botanists and 48 zoologists and physiologists, all of whose names are well-known. Common terms in the biological sciences are all covered, and even a good many more technical terms, such as amphidiploid, rhizocarpous, and macrurous. New terms of importance, such as plutonium, Rh factor, and streptomycin, are present. There are some lapses in the definition of scientific terms, e.g., "gene, the unit of inheritance . . . which develops into a hereditary character as it reacts with the environment and with the other genes"; "osmosis, the tendency of a fluid to pass through a semipermeable membrane into a solution whose concentration is lower (sic) . . ." But on the whole, a high degree of accuracy is maintained. The dictionary is more than satisfactory as a desk guide.

BENTLEY GLASS



NEW READINGS IN MEDICAL GERMAN.

By Oscar C. Burkhard and Lynwood G. Downs.
Henry Holt and Company, New York. \$3.25. xiii + 200 pp. + cxiii; ill. 1947.

This is the sort of book for which there is a great need. Medical students struggling to acquire an adequate reading knowledge of the German language in order to be able to read the medical literature in that tongue with some degree of ease will find here most of what they need, namely: an introductory section dealing with common difficulties; a list of 100 common anatomical terms; a list of frequent abbreviations; figures of body structure and parts labelled in German; a 24-page selection from Lorenzen's *Der menschliche Körper*; 4 pages, from Beltz' *Sachkunde*, on bacteria; 62 pages from *Die Krankheit, ihre Entstehung und Behandlung*, by Bock; 18 selections from medical journals and encyclopedias on a variety of medical topics; several short reviews and abstracts. Difficult idioms are translated in footnotes. An ample vocabulary list completes the book.

For graduate students in the biological sciences in

general, this treatment leaves something to be desired. The selections are too exclusively concerned with medicine, in particular with human anatomy and pathology. There is a corresponding restriction of vocabulary that omits general biological terms, especially in genetics, embryology, and evolution. The vocabularies of physiology, chemistry, and physics are likewise slighted. There is still a need for a book like this one in character, but directed to the biologist rather than the medical student. Until such a book is available, its place may be filled to a fair degree by the one under discussion.

BENTLEY GLASS



THE MICROSCOPE: Its Theory and Applications.

By J. H. Wredden, with an Historical Introduction by W. E. Watson-Baker. Grune & Stratton, New York.

\$5.50. xxiv + 296 pp. + 23 plates; text ill. 1948.

The author states in his preface that he has written this volume to provide a source of critical information about microscopy, for industrial laboratories in particular. Two chapters are devoted to optical principles, six to a comprehensive discussion of the parts of the microscope, one to its use, and these are followed by a chapter each on the polarizing microscope, micrometry, photomicrography, and the preparation of specimens for examination. In addition, a most useful appendix provides tables of refractive indices, conversion tables, logarithms and anti-logarithms, and natural sines. The subject matter is handled well and simply, numerous illustrations are provided, and several new innovations in technique and application are included, making this a desirable volume for both laboratory and class reference. It is to be regretted, from the biologist's point of view, that no information on the phase and electron microscopes is provided; but it is probable that their inclusion would have created a problem of space, and the material would be of little value to the industrial worker.

C. P. SWANSON



THE CENTRAL NORTHEAST. Look at America.

By the Editors of Look in Collaboration with Gerald W. Johnson. Houghton Mifflin Company, Boston.

\$5.00. 392 pp. + 1 map; text ill. 1948.

A fine pictorial survey of New York, New Jersey, Delaware, Pennsylvania, Maryland, West Virginia, and the District of Columbia. "Here," as Gerald Johnson puts it, "is the Main Entrance, the Front Office and behind it Plant Number One of the United States of America." This travel guide will convince any reader that it is also beautiful and full of historical interest.

INDEX

- Abbott, R. T., Handbook of Medically Important Mollusks of the Orient and the Western Pacific, 358
- Abramson, H. A., *et al.*, Non-Projective Personality Tests, 276
- Abribat, M., *et al.*, Techniques de Laboratoire, 385
- Activation energy and collision numbers, 204
- Adolph, E. F., *et al.*, Physiology of Man in the Desert, 69
- Adrian, E. D., The Physical Background of Perception, 170
- Alexander, H. L., Synopsis of Allergy, 179
- Allen, A. A., Ornithology Laboratory Notebook, 255
- Allorge, P., *et al.*, Contribution à l'Étude du Peuplement des Îles Atlantides, 233
- American Philosophical Society, America's Role in the Growth of Science, 43
- Amphibians, geographical distribution, 15
- Anderson, Betty, and Weil, B. H., Literature Search on the Preservation of Foods by Freezing, 264
- Anderson, C. G., Introduction to Bacteriological Chemistry, 76
- Anderson, R. M., Catalogue of Canadian Recent Mammals, 159
- Andrews, H. N., Jr., Ancient Plants, 142
- ANIMAL GROWTH AND DEVELOPMENT (book reviews), 67, 167, 258, 367
- ANIMAL MORPHOLOGY (book reviews), 64, 164, 256, 364
- ANIMAL NUTRITION (book reviews), 71, 171, 263, 376
- ANIMAL PHYSIOLOGY (book reviews), 68, 170, 259, 368
- Annales Biologiques, II, 161
- Annelids, giant axons of, 291
- Anthony, Catherine P., Textbook of Anatomy and Physiology, 364
- Antonov, A. N., Physiology and Pathology of the Newborn, 170
- Appicciafuoco, Romolo, La Psicologia Sperimentale di Sante de Sanctis, 274
- Area, climate, evolution, 109
- Asdell, S. A., Patterns of Mammalian Reproduction, 69
- Aswell, Mary L. (ed.), The World Within, 278
- Auber, Luc, Atlas des Coléoptères de France, I, II, III, 250
- Avery, G. S., and Johnson, Elizabeth B., Hormones and Horticulture, 243
- Axons, giant, of annelids, 291
- Ayers, Brother Benedict, The Genus *Cyperus* in Mexico, 57
- Babcock, E. B., The Genus *Crepis*, 352
- Bacq, Z. M., Travaux Récents sur les Toxiques de Guerre: Le BAL, 376
- Baetjer, Anna M., Women in Industry, 95
- Baker, J. R., Cytological Technique, 53
- Bald, J. G., *et al.*, Transmission of Potato Virus Diseases (5), 152
- Baldwin, A. L., *et al.*, Patterns of Parent Behavior, 85
- Baldwin, Ernest, Dynamic Aspects of Biochemistry, 72
- Barbeau, Marius, Alaska Beckons, 99
- Barker, R. G., *et al.*, Adjustment to Physical Handicap and Illness, 85
- Barnes, H. F., Gall Midges of Economic Importance, I, II, 63
- Barnhart, C. L. (ed.), American College Dictionary, 408
- Barrett, T. J., Harnessing the Earthworm, 361
- Barron, M. L., People Who Intermarry, 281
- Bauer, Walter, *et al.*, Teaching Psychotherapeutic Medicine, 188
- Baughman, I. P., Introduction to Chemistry, 174
- Baughman, J. L., Annotated Bibliography of Oysters, 358
- Beauchamp, W. L., *et al.*, Everyday Problems in Science, 137
- Discovering Our World, 43
- Behavior, schooling in fishes, 27
- Bench, G. N., *et al.*, Learning Guide in Biology, 340
- Benda, C. E., Mongolism and Cretinism, 82
- Benda, R., Le Granulo-Diagnostic de la Tuberculose, 394
- Benedek, Therese, Insight and Personality Adjustment, 89
- Bennett, H. H., Elements of Soil Conservation, 47
- Bennett, W. C., The Ethnogeographic Board, 192
- Bequaert, J. C., Monograph of the Strophocheilidae, 358
- Berg, Charles, Deep Analysis, 280
- Bergey's Manual of Determinative Bacteriology, 265
- Berghoff, Emanuel, Entwicklungsgeschichte des Krankheitsbegriffes, 178
- Bergman, H. D., and Hewitt, E. A., Laboratory Manual for Experimental Physiology, 370
- Berlioz, Jacques, Oiseaux de la Réunion, 158
- Bernard, Étienne, Le Climat Écologique, 235
- Berne, Eric, The Mind in Action, 279
- Bernheim, B. M., A Surgeon's Domain, 46
- BERRILL, N. J., and LIU, C. K., Germplasm, Weismann, and Hydrozoa, 124-132
- Bibby, Cyril, How Life is Handed on, 238
- Sex Education, 43
- Binet, Léon, Figures de Savants Français, 343
- BIOCHEMISTRY (book reviews), 72, 172, 264, 380
- BIOLOGY: HISTORY AND BIOGRAPHY (book reviews), 45, 137, 230, 342
- BIOMETRY (book reviews), 101, 194, 286, 406
- BIOPHYSICS (book reviews), 378
- Bishop, P. M. F., Gynaecological Endocrinology, 82
- Black, Max, Critical Thinking, 134

- Blackwelder, R. E., Checklist of the Coleopterous Insects of Mexico, Central America, the West Indies and South America (5), 251
 The Dates and Editions of Curtis' British Entomology, 60
- Blasdale, W. C., The Cultivated Species of *Primula*, 241
- Bogert, L. Jean, Diet and Personality, 377
- Bohart, R. M., and Ingram, R. L., Mosquitoes of Okinawa and Islands in the Central Pacific, 77
- Bond, James, Field Guide to Birds of the West Indies, 158
- Boulenger, E. G., Zoo Animals, 360
- Bounoure, L., L'Origine des Cellules Reproductrices, 147
- Boyd, William, Text-Book of Pathology, 178
 Fundamentals of Immunology, 178
- Brachet, Jean, Récents Progrès des Sciences Biologiques (Embryologie, Cytochimie, Génétique et Biochimie) aux États-Unis, 339
- Breder, C. M., Jr., Analysis of the Geometry of Symmetry with Especial Reference to the Squamation of Fishes, 64
- Breder, C. M., Jr., and Rasquin, Priscilla, Comparative Studies in the Light Sensitivity of Blind Characins from a Series of Mexican Caves, 69
- Breed, R. S., *et al.*, Bergey's Manual of Determinative Bacteriology, 265
- Brennan, Margaret, and Gill, M. M., Hypnotherapy, 277
- Brieger, E. M., The Papworth Families, 271
- Bronson, W. S., Starlings, 253
- Brophy, John, The Human Face, 67
- Brown, J. A. C., Psychiatry for Everyman, 277
- Brown, W. R., The Horse of the Desert, 363
- Brownell, C. L., and Williams, J. F., Active and Alert, 78
 Clean and Strong, 78
 Fit and Ready, 78
 Hale and Hearty, 78
 The Human Body, 78
 Living and Doing, 78
 Safe and Sound, 78
 Training for Living, 78
 Well and Happy, 78
- Brownell, C. L., *et al.*, Adventures in Growing Up, 78
 Being Alive, 78
 Health Problems, 78
 Youth Faces Maturity, 78
- Brownlee, K. A., Industrial Experimentation, 287
- Brues, C. T., Insects and Human Welfare, 159
- Buchanan, R. E., and St. John-Brooks, Ralph (eds.), Proposed Bacteriological Code of Nomenclature, 389
- Buchanan's Manual of Anatomy, 256
- Budker, P., La Vie des Requins, 61
- Bumpus, H. C., Jr., Hermon Carey Bumpus, 344
- Burch, A. B., Experimental Study of the Histological and Functional Differentiation of the Epithelial Hypophysis in *Hyla regilla*, 170
- Burdon, K. L., Textbook of Microbiology, 175
- Burkhard, O. C., and Downs, L. G., New Readings in Medical German, 409
- Burnet, F. M., The Background of Infectious Diseases in Man, 268
- Burnett, R. W., Life through the Ages, 349
- Burrows, E. G., Hawaiian Americans, 282
- Burt, Cyril, Intelligence and Fertility, 405
- Burt, Olive W., Luther Burbank, 344
- Buxton, P. A., The Louse, 177
- Cable, R. M., Illustrated Laboratory Manual of Parasitology, 76
- Cable, R. M., and Goodnight, C. J., Laboratory Guide for General Zoology, 154
- Calif. Bur. Marine Fisheries, The Commercial Fish Catch of California for the Years 1943 and 1944, 64
- Cameron, A. T., Recent Advances in Endocrinology, 170
- Caridroit, F., Psycho-Physiologie des Glandes Endocrines et du Système Neuro-Végétatif, 373
- Carnap, Rudolf, Meaning and Necessity, 335
- Carr, W. H., Desert Parade, 234
- Carrier enzymes, 219
- Carrighar, Sally, One Day at Teton Marsh, 233
- Carrington, Hereward, Psychic Science and Survival, 93
- Casier, H., and Delaunois, A. L., L'Intoxication par l'Alcool Éthylique, 376
- Castell, Alburey (ed.), Selections from the Essays of Thomas Henry Huxley, 336
- Catalases, 215
- Cattell, R. B., Description and Measurement of Personality, 88
- Caullery, Maurice, Organisme et Sexualité, 52
- Central nervous system and schooling of fishes, 29
- Chaigneau, André, Manuel du Piéteur, 163
- Chapman, H. H., and Meyer, W. H., Forest Valuation, 248
- Chase, W. H., Alaska's Mammoth Brown Bears, 360
- Chatterjee, M. N., Society in the Making, 94
- Chemical sensitivity and schooling of fishes, 28
- Chenoweth, L. B., and Selkirk, T. K., School Health Problems, 78
- Chester, K. S., The Nature and Prevention of the Cereal Rusts as Exemplified in the Leaf Rust of Wheat, 246
 Nature and Prevention of Plant Diseases, 245
- Chilean Nitrate Educational Bureau, Bibliography of References to the Literature on the Minor Elements and Their Relation to Plant and Animal Nutrition, 75
- Chrysler, M. A., and Edwards, J. L., The Ferns of New Jersey, 240
- Ciferri, R., Botanica Generale ed Agraria (III, 1), 351

- Clark, A. H., *Animals Alive*, 356
 A Monograph of the Existing Crinoids (I, 4b), 154
 Clark, B. L., and Durham, J. W., *Eocene Faunas from the Department of Bolivar, Colombia*, 143
 Clements, Edith S., *Flowers of Prairie and Woodland*, 150
 Clifton, Charles E., *et al.* (eds.), *Annual Review of Microbiology*, I, 386
 Climate and dispersal, 105
 Climate, area and evolution, 109, 115
 Cloud, P. E., Jr., *Terebratuloid Brachiopoda of the Silurian and Devonian*, 50
 Cockerell, T. D. A., *Zoölogy*, 249
 Colbert, E. H., *Sebecus*, Representative of a Peculiar Suborder of Fossil Crocodilia from Patagonia, 52
 Studies of the Phytosaurs *Machaerops* and *Rutiodon*, 51
 Cold-blooded vertebrates, geographical distribution of, 1
 Cole, A. B. (ed.), *A Scientist with Perry in Japan*, 344
 Collier, John, *The Indians of the Americas*, 189
 Collin, Remy, *L'Organisation Nerveuse*, 66
 Collision numbers and activation energy, 204
 Color vision and schooling of fishes, 27
 Columbia Univ. Statistical Research Group, *Selected Techniques of Statistical Analysis*, 195
 Conant, J. B., *On Understanding Science*, 133
 Conant, Roger, *Reptiles and Amphibians of the North-eastern States*, 156
 Conel, J. L., *The Postnatal Development of the Human Cerebral Cortex*, III, 68
 Cook, M. T., *Viruses and Virus Diseases of Plants*, 151
 Cosgrove, C. B., *Caves of the Upper Gila and Hueco Areas in New Mexico and Texas*, 191
 Cosslett, V. E., *The Electron Microscope*, 288
 Coward, Katharine H., *The Biological Standardisation of the Vitamins*, 377
 Craig, C. F., *Laboratory Diagnosis of Protozoan Diseases*, 389
 Cramér, Harald, *Mathematical Methods of Statistics*, 101
 Crandall, F. G., Jr., *It's an Allergy*, 81
 Cromwell, Gertrude E., *The Health of the School Child*, 77
 Cureton, T. K., *Physical Fitness, Appraisal and Guidance*, 390
 Physical Fitness Workbook, 391
 Curtin, L. S. M., *Healing Herbs of the Upper Rio Grande*, 355
 Curtis, G. D., *Bees' Ways*, 357
 Curtis, W. C., and Guthrie, Mary J., *Textbook of General Zoology*, 153
 Cushman, R. A., *A Generic Revision of the Ichneumonflies of the Tribe Ophionini*, 154
 Dahlgren, B. E., *Tropical and Subtropical Fruits*, 248
 Dale, Alan, *An Introduction to Social Biology*, 94
 Dallemagne, M. J., *Données Récentes sur la Nature et la Métabolisme de l'O₂*, 73
 D'Amour, F. E., and Blood, F. R., *Manual for Laboratory Work in Mammalian Physiology*, 369
 Daniels, Lucille, *et al.*, *Muscle Testing*, 374
 Dann, W. J., and Satterfield, G. H. (eds.), *Estimation of the Vitamins*, 263
 DARLINGTON, P. J., JR., *The Geographical Distribution of Cold-blooded Vertebrates*, 1-26; 105-123
 Daubenmire, R. F., *Plants and Environment*, 234
 Davidson, L. S. P., and Anderson, I. A., *Textbook of Dietetics*, 376
 Davis, A. C., *Review of the Weevils of the Tribe Ophryastini of America North of Mexico*, 154
 Davis, F. B., *Utilizing Human Talent*, 86
 Davis, Hallowell (ed.), *Hearing and Deafness*, 181
 Davis, T. L. (ed.), *Chymia*, 408
 Davison's *Mammalian Anatomy*, 166
 Davitashvili, L. Sh., V. O. Kovalevsky, 139
 Daw, S. E., *et al.*, *We Live and Grow*, 341
 DE OMNIBUS REBUS ET QUIBUSDAM ALIIS (book reviews), 103, 195, 287, 408
 Deakin, Alan, *Animal Genetics and the Inhibiting Factor Hypothesis*, 148
 Causes of Color Patterns in Plants and an Inhibiting Factor Hypothesis, 148
 Causes of the Zebra and Other Patterns, 148
 A Critique of Major Biological Principles and Theories, 148
 Identical Cattle Twins and Causes of Spotted Patterns, 148
 Dehydrogenases, 219
 Delacour, Jean, *Birds of Malaysia*, 158
 de Laubenfels, M. W., *Life Science*, 136
 Demerec, M. (ed.), *Advances in Genetics*, II, 350
 Demolon, Albert, *Croissance des Végétaux Cultivés*, 243
 Denhardt, R. M., *The Horse of the Americas*, 363
 Dennis, Wayne, *et al.*, *Current Trends in Psychology*, 182
 DeRobertis, E. D. P., *et al.*, *General Cytology*, 349
 Descartes, René, *The Living Thoughts of*, 42
 Deutsch, Albert (ed.), *Sex Habits of American Men*, 397
 DeWaele, Henri, J.-B. Van Helmont, 138
 Dialectical Materialism and Scientific Research, 333-335
 Dible, J. H., and Davie, T. B., *Pathology*, 178
 Dichter, Ernest, *The Psychology of Everyday Living*, 87
 Dickson, James G., *Diseases of Field Crops*, 247
 Dispersal and climate, 105
 Dispersal between Old and New Worlds, 107
 Dispersal, main pattern, 111
 Ditmars, R. L., *Thrills of a Naturalist's Quest*, 47
 Domagk, Gerliard, and Hegler, Carl, *Chemotherapie bakterieller Infektionen*, 270
 Douglas, Marjory S., *The Everglades*, 346
 Drinker, C. K., *et al.*, *Psychiatric Research*, 187

- Duchateau, Ghislaine, Méthodes Nouvelles d'Analyse Biochimique et Clinique, 73
- Dufresne, Frank, Alaska's Animals and Fishes, 155
- Duggan-Cronin, A. M., The Bantu Tribes of South Africa. The Nguni: The Swazi, 98
- Dukes, H. H., *et al.*, The Physiology of Domestic Animals, 370
- Durham, J. W., Corals from the Gulf of California and the North Pacific Coast of America, 50
- Duthie, E. S., Molecules Against Microbes, 270
- Dye, J. A., Human Physiology Syllabus, 371
- Dyk, Walter, A Navaho Autobiography, 101
- Eames, A. J., and MacDaniels, L. H., Introduction to Plant Anatomy, 152
- Eastman, N. J., Expectant Motherhood, 82
- Ebaugh, F. G., *et al.* (eds.), Military Neuropsychiatry, 89
- Eckman, James, Jerome Cardan, 137
- ECOLOGY AND NATURAL HISTORY (book reviews), 47, 140, 233, 345
- ECONOMIC BOTANY (book reviews), 58, 151, 243, 354
- ECONOMIC ZOOLOGY (book reviews), 63, 159, 256, 361
- Eddy, Samuel, *et al.*, Guide to the Study of the Anatomy of the Shark, *Necturus*, and the Cat, 65
- Edinger, Tilly, Evolution of the Horse Brain, 144
- Edminster, F. C., Fish Ponds, 161
- Eggston, A. A., and Wolff, Dorothy, Histopathology of the Ear, Nose and Throat, 80
- Ehrenwald, Jan, Telepathy and Medical Psychology, 398
- Ellinger, Friedrich, Biologic Fundamentals of Radiation Therapy, 379
- Elliott, H. C., Textbook of the Nervous System, 367
- Ellis, M. M., Toxicity of Phenyl-Mercuric Lactate for Fish, 64
- Ellis, M. M., *et al.*, Water Quality Studies of the Delaware River with Reference to Shad Migration, 64
- Emerson, F. W., Basic Botany, 54
- Engle, E. T. (ed.), The Problem of Fertility, 83
- Enzymatic oxidations and reductions, 197
activation energy and collision numbers, 204
carrier enzymes, 219
catalases, 215
collision numbers and activation energy, 204
dehydrogenases, 219
flavoproteins, 221
Michaelis-Menton theory, extended, 223
oxidases, 212
peroxidases, 215
rate laws and mechanism of reactions, 209
reaction kinetics and semiquinones, 207
reaction mechanisms and rate laws, 209
semiquinones and reaction kinetics, 207
- Erwin, G. S., Guide for the Tuberculous Patient, 180
- Etheredge, Maude L., Health Facts for College Students, 79
- Evans, R. M., An Introduction to Color, 379
- EVOLUTION (book reviews), 48, 141, 237, 348
- Evolution and principle of stability, 324
- Evolution, area and climate, 109
- Faculté de Pharmacie de Nancy, Trav. du Lab. de Microbiologie, XV, 175
- Fairchild, David, The World Grows Round My Door, 139
- Fairchild, L. H., and Helen G., Cats and All About them, 255
- Fearon, W. R., Introduction to Biochemistry, 172
- Fendrich, J. L., Jr., Mental Hygiene, 277
- Fenton, C. L., and Kambly, P. E., Basic Biology for High Schools, 340
- Finney, D. J., Probit Analysis, 102
- Fishes, schooling behavior, 27
- Flavoproteins, 221
- Fleury, Paul, and Balatre, Paul, Les Inositols, 264
- Flint, R. F., Glacial Geology, 145
- Florkin, Marcel, Aperçus sur les Progrès de la Biochimie dans les Pays Anglo-Saxons depuis 1940, 73
L'Evolution du Métabolisme des Substances Azotées chez les Animaux, 73
- Florkin, Marcel. (ed.), Un Symposium sur les Protéines, 381
- Flugel, J. C., Men and Their Motives, 92
- Follis, R. H., Jr., The Pathology of Nutritional Disease, 271
- Ford, F. R., Diseases of the Nervous System, 81
- Foreman, Grant, The Last Trek of the Indians, 99
- Form and size, and schooling of fishes, 27
- Foxe, A. N., Plague, 343
- François, Louis, Semences et Premières Phases du Développement des Plantes, 244
- Franklin, G. C., Wild Animals, 255
- Franklin Institute, Biochemical Research Foundation, Reports of, VIII, 75
- Franklin, K. J., *et al.*, The Circulation in the Foetus, 258
- Franklin, T. B., Science and Reality, 229
- Fraser, F. C., Report on Cetacea, 62
- Frazier, E. F., The Negro Family in the United States, 404
- Frear, D. E. H., A Catalogue of Insecticides and Fungicides, I, 361
- Fredericq, Pierre, Données Récentes sur la Coagulation du Sang, 73
- Free, Montague, Gardening, 354
- Fresh-water fishes, geographical distribution, 4
- Frey-Wyssling, A., Submicroscopic Morphology of Protoplasm and Its Derivatives, 349
- Friedlander, Kate, The Psycho-analytical Approach to Juvenile Delinquency, 402
- Friedmann, Herbert, Birds Collected by the National Geographic Society's Expeditions to Northern Brazil and Southern Venezuela, 359

- Frödin, John, Zentraleuropas Alpwirtschaft, I, II, 98
- Frohman, B. S., Brief Psychotherapy, 400
- Fromm, Erich, Man for Himself, 276
- Fuller, H. J., Outline of General Botany, 352
- Fuller, R. T., Nature Quests and Quizzes, 347
- Furon, Raymond, Formulaire Technique du Pré-historien, 146
- Gaarenstroom, J. H., and DeJongh, S. E., A Contribution to the Knowledge of the Influences of Gonadotropic and Sex Hormones on the Gonads of Rats, 260
- Galtsoff, P. S., Red Tide, 363
- Gamble, J. L., Chemical Anatomy, Physiology and Pathology of Extracellular Fluid, 373
- Gardner, Ernest, Fundamentals of Neurology, 367
- Gardner, Julia, Mollusca of the Tertiary Formations of Northeastern Mexico, 144
- Garner, F. H., British Dairying, 163
- Garrison, K. C., The Psychology of Adolescence, 186
- Gates, A. I., and Kushner, Rose E., Learning to Use Hearing Aids, 276
- Gates, R. R., Human Ancestry, 146
- Gatz, A. J., Outline Manual for the Study of Histology, 365
- Gäumann, Ernst, Pflanzliche Infektionslehre, 246
- GENERAL AND SYSTEMATIC BOTANY (book reviews), 53, 150, 239, 351
- GENERAL AND SYSTEMATIC ZOOLOGY (book reviews), 59, 153, 249, 356
- GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION (book reviews), 42, 133, 229, 335
- GENERAL PHYSIOLOGY (book reviews), 149
- GENETICS AND CYTOLOGY (book reviews), 52, 147, 237, 349
- Geographical distribution
- amphibians, 15
 - area, climate, evolution, 109
 - climate and dispersal, 105
 - climate, area and evolution, 109, 115
 - cold-blooded vertebrates, 1
 - dispersal and climate, 105
 - dispersal between Old and New Worlds, 107
 - dispersal, main pattern, 111
 - evolution, area and climate, 109
 - fresh-water fishes, 4
 - land bridges, ancient, 115
 - reptiles, 22
 - spreading and receding of animals, 1
 - vertebrates, cold-blooded, 1
- Geographical distribution of cold-blooded vertebrates, 1-26; 105-123
- Germplasm, Weismann, and Hydrozoa, 124-132
- Gesell, Arnold, and Amatruda, Catherine S., Developmental Diagnosis, 184
- Gholson, Rev. Edward, The Negro Looks into the South, 282
- Giant axons of annelids, 291-323
- Gillin, John, The Ways of Men, 286
- GLASS, BENTLEY, Dialectical Materialism and Scientific Research, 333-335
- Sexual Behavior in the Human Male, White, U.S.A., 39-42
- Gomes, A. Lourenço, A Small Collection of Fishes from Rio Grande do Sul, Brazil, 61
- Good, Ronald, The Geography of the Flowering Plants, 348
- Goodall, D. W., and Gregory, F. G., Chemical Composition of Plants as an Index of Their Nutritional Status, 353
- Gorer, Geoffrey, The American People, 281
- Graham, E. H., The Land and Wildlife, 140
- Grant, J. C. B., Atlas of Anatomy, 65
- Green, D. E. (ed.), Currents in Biochemical Research, 72
- Greenacre, Phyllis, *et al.* (eds.), The Psychoanalytic Study of the Child, II, 91
- Gregory, W. K., The Monotremes and the Palimpsest Theory, 52
- Griscom, Ludlow, and Folger, Edith V., The Birds of Nantucket, 253
- Gross, Martin, and Greenberg, L. A., The Salicylates, 375
- Grüneberg, Hans, Animal Genetics and Medicine, 148
- Gurwitsch, Alexandre, Une Théorie du Champ Biologique Cellulaire, 258
- Gustafson, A. F., *et al.*, Land for the Family, 288
- Hadfield, Geoffrey, and Garrod, L. P., Recent Advances in Pathology, 393
- Hagan, W. A., *et al.*, The Relation of Diseases in the Lower Animals to Human Welfare, 163
- Haile, Father Berard, Navaho Sacrificial Figurines, 282
- Prayer Stick Cutting in a Five Night Navaho Ceremonial of the Male Branch of Shootingway, 282
- Haldane, J. B. S., What Is Life? 230
- Hall, Sir A. D., *et al.*, The Feeding of Crops and Stock, 353
- Hambly, W. D., Cranial Capacities, A Study in Methods, 167
- Hamilton, Gordon, Psychotherapy in Child Guidance, 400
- Hammer, B. W., Dairy Bacteriology, 267
- Hammond, John, *et al.*, The Artificial Insemination of Cattle, 256
- Hampe, I. E., and Kolb, Haven, A Preliminary List of Birds of Maryland and the District of Columbia, 157
- Handley, C. O., Jr., and Patton, C. P., Wild Mammals of Virginia, 159
- Hannum, C. A., and Brown, W. H., Laboratory Text in Elementary Zoölogy, 153
- Harding, T. S., Two Blades of Grass, 232
- Harpster, Hilda T., The Insect World, 251
- Harrell, Ruth F., Further Effects of Added Thiamin on Learning and Other Processes, 275

- Harriman, P. L., *Encyclopedia of Psychology*, 85
- Harris, Clare W., *Away from the Here and Now*, 196
- Harris, R. S., and Thimann, K. V. (eds.), *Vitamins and Hormones*, IV, 74; V, 383
- Hartley, Ruth E., *Sociality in Preadolescent Boys*, 193
- Hartwell, S. W., *Practical Psychiatry and Mental Hygiene*, 188
- Hartwig, Nelle A., *A Laboratory Manual of General Physiology*, 370
- Harvey, A. G., *Douglas of the Fir*, 231
- Hauduroy, Paul, *Microbiologie Générale et Technique Microbiologique*, 388
- Haupt, A. W., *Laboratory Manual of Elementary Botany*, 239
- Hausman, L. A., *Birds of Prey of Northeastern North America*, 253
- The Illustrated *Encyclopedia of American Birds*, 157
- Hawes, Ina L., and Eisenberg, Rose, *Bibliography on Aviation and Economic Entomology*, 161
- Hawley, R. C., *The Practice of Silviculture*, 355
- Headlee, Raymond, and Corey, Bonnie W., *Psychiatry in Nursing*, 400
- HEALTH AND DISEASE (book reviews), 77, 178, 268, 390
- Henderson, D. K., *Psychopathic States*, 188
- Henry, G. W., *Sex Variants*, 280
- Henry, Marguerite, *Virgin Islands*, 283
- Herrick, C. J., *The Brain of the Tiger Salamander *Ambystoma tigrinum**, 257
- Herzberger, Max, *The Limitations of Optical Image Formation*, 103
- Hill, J. M., and Dameshek, William, *The Rh Factor in the Clinic and the Laboratory*, 262
- Hoel, P. G., *Introduction to Mathematical Statistics*, 406
- Hoff, C. C., *The Species of the Pseudoscorpion Genus *Chelanops* Described by Banks*, 356
- Holland, R. P., *Bird Dogs*, 363
- Holmes, S. J., *Life and Morals*, 338
- HOLMES, S. J., *The Principle of Stability as a Cause of Evolution*, 324-332
- Honigman, J. J., *Ethnography and Acculturation of the Fort Nelson Slave*, 190
- Hopkins, D. P., *Chemicals, Humus, and the Soil*, 235
- Howard, A. L., *Trees in Britain*, 48
- Howard, H. W., *Salmon Fishing on Puget Sound*, 289
- Howell, B. F., *Revision of the Upper Cambrian Faunas of New Jersey*, 141
- Hsiao, T. Y., and Bohart, R. M., *The Mosquitoes of Japan and Their Medical Importance*, 77
- Hubbs, C. L., and Black, J. D., *Revision of *Ceratichthys*, a Genus of American Cyprinid Fishes*, 61
- Hubbs, C. L., and Lagler, K. F., *Fishes of the Great Lakes Region*, 155
- Hubbs, C. L., and Raney, E. C., *Endemic Fish Fauna of Lake Waccamaw, North Carolina*, 61
- Hudson, P. S., and Richens, R. H., *The New Genetics in the Soviet Union*, 333
- Hull, T. G., *Diseases Transmitted from Animals to Man*, 79
- HUMAN BIOLOGY (book reviews), 94, 188, 281, 403
- Huxley, Julian, *Man in the Modern World*, 336
- Huxley, T. H., *Selections from the Essays of*, 336
- Huybrechts, M., *Le pH et sa Mesure*, 380
- Hydrobiologia, 347
- Hydrozoa, *germplasm and Weismann*, 124
- Inst. Bot., Univ. Montréal, *Contributions* (56), 57
- Ipcar, Dahlov, *Animal Hide and Seek*, 348
- Ives, Paul, *Domestic Geese and Ducks*, 162
- Jaggard, T. A., *Origin and Development of Craters*, 103
- Jaques, H. E., *Living Things*, 136
- Jeannel, R., *Introduction à l'Entomologie*, I, II, III, 250
- Jenkins, Dorothy H., *Around the Garden*, 59
- Jensen, Einar, *Danish Agriculture*, 245
- Jewish Encyclopedic Handbooks, *The Jewish People*, I, 96
- Joad, C. E. M., *How Our Minds Work*, 184
- Johnson, Frederick (ed.), *Man in Northeastern North America*, 99
- Johnson, Frederick, and Raup, H. M., *Grassy Island*, 190
- Jones, F. W., *The Life Cycle of a Plant*, 239
- Jones, F. Wood (ed.), *Buchanan's Manual of Anatomy*, 256
- Jones, W. H. S., *The Medical Writings of Anonymous Londinensis*, 137
- Jordan, Charles, *Calculus of Finite Differences*, 408
- Jordan, H. E., *Textbook of Histology*, 364
- Jordan, H. E., and Kindred, J. E., *Textbook of Embryology*, 169
- Jørgensen, Holger, *Studies on the Nature of the Bromate Effect*, 71
- Kahn, R. A., and Rounsefell, G. A., *Evaluation of Fisheries in Determining Benefits and Losses from Engineering Projects*, 64
- Kalmus, H., *Genetics*, 351
- Kambly, P. E., *Workbook and Laboratory Manual to Accompany Basic Biology*, 340
- Kamen, M. D., *Survey of Contemporary Knowledge of Biogeochemistry*, I, 75
- Katz, David, *Psychological Atlas*, 274
- Katz, Sander (ed.), *Freud: on War, Sex and Neurosis*, 278
- Keen, B. A., *The Agricultural Development of the Middle East*, 58
- Keers, R. Y., and Rigden, B. G., *Pulmonary Tuberculosis*, 270
- Keiner, S. S., *Doctor, Don't Let Me Die!* 231
- Keith, Sir Arthur, *Essays on Human Evolution*, 48
- Evolution and Ethics, 338
- Keller, A. G., *Societal Evolution*, 405
- Kelley, T. L., *Fundamentals of Statistics*, 407

- Kendall, J. I., *Microscopic Anatomy of Vertebrates*, 165
- Kenneth, J. H., *Gestation Periods*, 169
- King, B. G., and Roser, Helen M., *Anatomy and Physiology Laboratory Manual and Study Guide*, 364
- King, F. H., *Farmers of Forty Centuries*, 285
- Kinsey, A. C., *et al.*, *Sexual Behavior in the Human Male*, 39
- Kirk, Dudley, *Europe's Population in the Interwar Years*, 193
- Kissin, Rita, *Desert Animals*, 255
- Kittredge, Joseph, *Forest Influences*, 345
- Kleiner, I. S., and Dotti, L. B., *Laboratory Instructions in Biochemistry*, 385
- Kling, S. G. and Esther B. (eds.), *The Marriage Reader*, 194
- Klingersmith, Stacy, *Guardians of the Forest*, 152
- Klyne, Wm., *Practical Chemistry*, 172
- Knaggs, N. S., *Adventures in Man's First Plastic*, 355
- Knechtel, M. M., *et al.*, *Mesozoic Fossils of the Peruvian Andes*, 348
- Kniffen, F. B., *The Indians of Louisiana*, 100
- Knowles, F. G. W., *Man and Other Living Things*, 194
- Knudson, A. C., *The Philosophy of War and Peace*, 95
- Koch, F. C., and Hanke, M. E., *Practical Methods in Biochemistry*, 384
- Köhler, Wolfgang, *Gestalt Psychology*, 397
- Kolloen, L. N., and Elling, C. H., *Outlook for the Alaska Herring Fishery in 1948*, 363
- Kolmogoroff, A., *Grundbegriffe der Wahrscheinlichkeitsrechnung*, 407
- Krauss, Helen K., *Begonias for American Homes and Gardens*, 242
- Kroeber, A. L., *Configurations of Culture Growth*, 188
- Cultural and Natural Areas of Native North America*, 189
- Kronfeld, P. C., *et al.*, *The Human Eye in Anatomical Transparencies*, 66
- Kucyniak, James, *A Preliminary Survey of Bryological Research in Quebec*, 151
- Kungl. Fysiografiska Sällskapet i Lund Förhandlingar, 103
- Kuper, Hilda, *An African Aristocracy*, 192
- Kushner, Rose E., *The Relationship Between Content of an Adult Intelligence Test and Intelligence Test Score as a Function of Age*, 186
- LaBarre, Jean, and Thomas, Jaques, *Dosage Biologique et Contrôle des Médicaments*, 375
- Lamarque, Paul, *Les Bases Physiques et Biologiques de la Roentgenthérapie*, 379
- Lamson, Mary D., *Gardening with Shrubs*, 58
- Land bridges, ancient, 115
- Landis, P. H., *Your Marriage and Family Living*, 281
- LaPiere, R. T., *Sociology*, 94
- LaRoe, Else K., *Care of the Breast*, 394
- Lash, G. M., *Review Digest of Biology*, 340
- Laurie, Alex, and Kiplinger, D. C., *Commercial Flower Forcing*, 354
- Leary, J. C., *et al.*, *D D T*, 159
- Leboucq, Georges, *André Vésale*, 137
- LeCerf, F., *Atlas des Lépidoptères de France*, I, 250
- LeCron, L. M., and Bordeaux, Jean, *Hypnotism Today*, 92
- Legendre, René, *Histoires de Mer*, 59
- Lemmon, R. S., *How To Attract the Birds*, 360
- Lesbouyries, G., *La Pathologie des Oiseaux*, 162
- Lespagnol, A., *Quelques Aspects de la Chimie des Médicaments*, 384
- Levi, Giuseppe, *Trattato di Istologia*, 164
- Liber, B., *Practical Psychiatry*, 279
- Licht, Sidney, *Music in Medicine*, 84
- Liébecq, Claude, *Conception Actuelle du Catabolisme de l'Hémoglobine*, 73
- Lillard, R. G., *The Great Forest*, 152
- Lillie, R. D., *Histopathologic Technic*, 392
- Look, Editors of, *The Central Northeast*, 409
- Lorand, Sandor (ed.), *The Yearbook of Psychoanalysis*, III, 401
- Louyot, P., *Le Sel en Biologie*, 261
- Low, R. C., and Dodds, T. C., *Atlas of Bacteriology*, 266
- Lowdermilk, W. C., *Palestine*, 96
- Lowrie, R. H., *Primitive Society*, 283
- Lowrey, L. G., *Psychiatry for Social Workers*, 90
- Luck, J. M., *et al.* (eds.), *Annual Reviews of Biochemistry*, XVI, 73
- Lull, R. S., *Organic Evolution*, 49
- Lund, E. J., *et al.*, *Bioelectric Fields and Growth*, 149
- Lunenburg, R. K., *Mathematical Analysis of Binocular Vision*, 171
- Lutz, H. J., and Chandler, R. F., Jr., *Forest Soils*, 47
- LUVALLE, JAMES E., and GODDARD, DAVID R., *The Mechanism of Enzymatic Oxidations and Reductions*, 197-228
- Lynch, J. J., *et al.*, *Effects of Aquatic Weed Infestations on the Fish and Wildlife of the Gulf States*, 64
- Lynde, C. J., *Science Experiences with Home Equipment*, 103
- MacDonald, Malcolm, *The Birds of Brewery Creek*, 254
- MacDuffee, C. C., *The Theory of Matrices*, 408
- MacFadyen, Mary, *Beauty Plus*, 395
- Building Skin Beauty*, 179
- Mahaux, Jacques, *Essai de Physiopathologie Thyro-Hypophysaire*, 180
- Marriott, Alice, *Marfa: the Potter of San Ildefonso*, 403
- Marshall, James, *The Venereal Diseases*, 83
- Marshall, M. S., *Applied Medical Bacteriology*, 269
- Martin, P. S., *et al.*, *Indians before Columbus*, 98
- Marx, D. S., *The American Book of the Woods*, 151
- Fragrant Herbs*, 152
- Learn the Trees from Leaf Prints*, 151
- Let's Look at the Plant World*, 150
- Mason, G. F., *Animal Homes*, 233

- Mason, J. A., Notes on the Indians of the Great Slave Lake Area, 190
- Massart, L., Acquisitions Récentes dans le Domaine de l'Enzymologie, 73
- Biochimie et Médecine, 383
- Masters, David, Miracle Drug, 396
- Mathematical Tables Project, National Bureau of Standards, Table of the Bessel Functions $J_0(z)$ and $J_1(z)$, 102
- Tables of Spherical Bessel Functions, I, II, 102
- Mathot, H. J., Factoren die de Variatie van het Vitamine C in de Plant Bepalen, 249
- Het Vitamine-C-gehalte van Vroege Aardappelen, Bepalingsmethode en Oriënterend Onderzoek, 249
- Mavor, J. W., General Biology, 136
- Laboratory Exercises in General Biology, 136
- Maynard, L. A., Animal Nutrition, 71
- McCance, R. A., and Widdowson, E. M., The Chemical Composition of Foods, 377
- McCracken, Harold, and VanCleve, Harry, Trapping, 256
- McDowall, R. J. S., Handbook of Physiology and Biochemistry, 170
- McFarland, J. H., Roses of the World in Color, 242
- McGrath, E. J., *et al.*, Toward General Education, 341
- McHatton, T. H., Armchair Gardening, 244
- McHugh, Gelolo, Developing Your Child's Personality, 275
- McIntyre, A. R., Curare, 261
- McKee, E. D., and Resser, C. E., Cambrian History of the Grand Canyon Region, 141
- McMillen, Wheeler, New Riches from the Soil, 244
- McSpadden, J. W. (ed.), Animals of the World, 61
- Mead, Margaret, The Mountain Arapesh, III, IV, 192
- Mechanism of enzymatic oxidations and reductions, 197-228
- Merchant, I. A., Veterinary Bacteriology, 269
- Messer, H. M., The Dissection of the Cat, 65
- Mettler, Cecilia C., History of Medicine, 342
- Michaelis-Menton theory, extended, 223
- Michener, C. D., A Revision of the American Species of Hoplitids (Hymenoptera, Megachilidae), 251
- Mickey, Margaret P., The Cowrie Shell Miao of Kweichow, 403
- MICROBIOLOGY (book reviews), 76, 174, 265, 386
- Middleton, A. R., Workbook in the Introduction to the Biological Sciences, 45
- Miller, C. W., A Scientist's Approach to Religion, 42
- Miller, R. R., The Cyprinodont Fishes of the Death Valley System of Eastern California and Southwestern Nevada, 256
- Milne, L. J. and Margery J., A Multitude of Living Things, 59
- Missenard, André, La Chaleur Animale, 259
- Mitchell, J. W., and Marth, P. C., Growth Regulators, 243
- Moe, Virginia, Animal Inn, 60
- Moncrieff, R. W., The Chemical Senses, 68
- Montgomery, E. S., The Bull Terrier, 164
- Montgomery, R. B., *et al.*, Convection Patterns in the Atmosphere and Ocean, 103
- Moon, T. J., *et al.*, Modern Biology, 44
- Moreau, F., Alcaloïdes et Plantes Alcaloïfères, 247
- Moret, Léon, Manuel de Paléontologie Végétale, 142
- Morgan, B. B., and Hawkins, P. A., Veterinary Protozoology, 390
- Morice, E., Méthodes Statistiques en Médecine et en Biologie, 194
- Morris, P. A., A Field Guide to the Shells of Our Atlantic Coast, 249
- MORROW, JAMES E., JR., Schooling Behavior in Fishes, 27-38
- Morton, C. V., The American Species of Hymenophyllum Section Sphaerocionium, 151
- Morton, Kendal and Julia, Fifty Tropical Fruits of Nassau, 59
- Motion and schooling of fishes, 27
- Mueller, C. H., Bulbs for Beauty, 242
- Murphy, Gardner, Personality, 88
- Murphy, R. C., Oceanic Birds of South America, I, II, 252
- Murray, J. J., Wild Wings, 254
- Mursell, J. L., Psychological Testing, 186
- Mycopathologia, 387
- Nadel, S. F., The Nuba, 404
- Nelson, A. L., and Surber, E. W., DDT Investigations by the Fish and Wildlife Service in 1946, 64
- Nesbitt, Nell S., Bumpy Bison, 63
- New Biology (2, 3, 4), 339
- Newburgh, L. H., The Significance of the Extracellular Fluid in Clinical Medicine, 373
- Newman, B. M., Vitalized General Science, 44
- Newman, M. T., and Willey, G. R., Indian Skeletal Material from the Central Coast of Peru, 191
- New York Academy of Medicine, Medicine in the Post-war World, 396
- Medicine Today, 268
- Nicholas, B. M., When I Hid in the Marsh, 254
- Nickerson, W. J. (ed.), Biology of Pathogenic Fungi, 386
- NICOL, J. A. COLIN, The Giant Axons of Annelids, 291-323
- Nicole, J. E., Psychopathology, 277
- Nord, F. F. (ed.), Advances in Enzymology, VII, 382
- Northey, E. H., The Sulfonamides and Allied Compounds, 264
- Northrop, J. H., *et al.*, Crystalline Enzymes, 381
- Nucleic acid, 173
- Odum, H. W., The Way of the South, 282
- Ogilvie, R. F., Pathological Histology, 392
- Orlando, Fla., Lab. Bur. Entom. Plant Quarantine,

- DDT and Other Insecticides and Repellents Developed for the Armed Forces, 160
- Outdoor Life's Gallery of North American Game, 64
- Oxidases, 212
- Oxidations and reductions, enzymatic, 197
- Palmquist, E. M., and Petry, L. C., General Botany Laboratory Book, 55
- PARASITOLOGY (book reviews), 76, 177, 267, 389
- Parker, F. P., Textbook of Clinical Pathology, 393
- Parker, G. H., Animal Colour Changes and Their Neurohumours, 368
- Pasquini, Pasquale, Le Forze Creatrici dell'Uovo, 367
- Paulian, Renaud, Observations Écologiques en Forêt de Basse Côte d'Ivoire, 345
- Pauling, Linus, General Chemistry, 380
- Pellett, F. C., American Honey Plants, 354
- Pelseneer, Jean, Morale de Savants, 135
- Peltier, G. L., *et al.*, Laboratory Manual for General Bacteriology, 388
- Percival, Olive, Our Old-Fashioned Flowers, 242
- Peroxidases, 215
- Peters, W. H., and Deyoe, G. P., Raising Livestock, 363
- Peterson, A. M., Wild Bird Neighbors, 254
- Pfeiffer, Ehrenfried, The Earth's Face and Human Destiny, 285
- Pickwell, Gayle, Amphibians and Reptiles of the Pacific States, 155
- Pierce, E. L., An Annual Cycle of the Plankton and Chemistry of Four Aquatic Habitats in Northern Florida, 236
- Pike, O. G., Nature and My Cine Camera, 347
- Pike, W. S., Jr., Intertonguing Marine and Nonmarine Upper Cretaceous Deposits of New Mexico, Arizona, and Southwestern Colorado, 196
- Pillsbury, W. B., and Pennington, L. A., Handbook of General Psychology, 274
- Pilsbry, H. A., Land Mollusca of North America North of Mexico, 357
- Pincher, Chapman, The Breeding of Farm Animals, 164
- Pinch, L. A., A Biochemical Hypothesis of the Genesis of Cancer, 385
- Pincus, Gregory (ed.), Recent Progress in Hormone Research, I, 74; II, 372
- Pinkerton, Kathrene, Bright with Silver, 362
- Pistorius, Anna, What Animal Is It? 255
- PLANT MORPHOLOGY (book reviews), 152
- PLANT PHYSIOLOGY (book reviews), 153, 353
- Platt, Rutherford, Our Flowering World, 237
- Plenn, Abel, The Southern Americas, 283
- Podolsky, Edward, The Thinking Machine, 184
- Pohl, R. W., A Taxonomic Study on the Grasses of Pennsylvania, 241
- Polyak, S. L., *et al.*, The Human Ear in Anatomical Transparencies, 167
- Popowski, Bert, Hunting Small Game, 362
- Pottenger, F. M., Tuberculosis, 394
- Potter, Edith L., Rh, 80
- Potter, G. E., Textbook of Zoology, 153
- Poucel, J., À la Découverte des Orchidées de France, 240
- Poutiers, Raymond, Atlas des Parasites des Cultures, I, II, 77
- Powers, S. R., *et al.*, Our World Changes, 44
- Preston, R. J., Rocky Mountain Trees, 352
- Price, C. C., Mechanisms of Reactions at Carbon-Carbon Double Bonds, 380
- Principle of stability as a cause of evolution, 324
- PSYCHOLOGY AND ANIMAL BEHAVIOR (book reviews), 85, 182, 273, 397
- Putnam, Brenda, Animal X-rays, 367
- Quain, Buell, Fijian Village, 403
- Radke, Marian J., The Relation of Parental Authority to Children's Behavior and Attitudes, 85
- Rainey, F. G., The Whale Hunters of Tigara, 403
- Rate laws and mechanism of reactions, 209
- Rayner, M. C., Trees and Toadstools, 243
- Reaction kinetics and semiquinones, 207
- Reaction mechanisms and rate laws, 209
- Reik, Theodor, Ritual: Psycho-Analytic Studies, 279
- Rempel, A. G., The Origin and Differentiation of the Larval Head Musculature of *Triturus torosus* (Rathke), 170
- Renaux, Ernest, *et al.*, Aperçu de l'Histoire de la Médecine en Belgique, 231
- Renborg, B. A., International Drug Control, 395
- Reptiles, geographical distribution, 22
- Research, 195
- Reyniers, J. A. (ed.), Germ-Free Life Studies, 175
- Rhind, D., The Grasses of Burma, 150
- Rice, Mabel A., Trees and Shrubs of Nantucket, 57
- Rice, T. B., Sex, Marriage and Family, 281
- A Textbook of Bacteriology, 176
- Richards, Esther L., Introduction to Psychobiology and Psychiatry, 279
- Richards, T. W., Modern Clinical Psychology, 90
- Richter, K. M., A Work-Test on Human Embryology, 169
- Rickett, H. W., The Royal Botanical Expedition to New Spain, 139
- Riddle, Oscar, Endocrines and Constitution, 262
- Riddle, Oscar, *et al.*, Studies on Carbohydrate and Fat Metabolism, 262
- Rideal, E. K., *et al.*, Colloid Science, 173
- Riedman, Sarah R., How Man Discovered His Body, 230
- Rights, D. L., The American Indian in North Carolina, 101
- Riley, H. P., Introduction to Genetics and Cytogenetics, 237
- Robinson, G. W., Mother Earth, 236
- Rodgers, T. L., and Fitch, H. S., Variation in the Skinks (Reptilia: Lacertilia) of the skiltonianus Group, 252

- Rodnick, David, Postwar Germans, 405
- Rogick, Mary D., General Zoology Laboratory Manual, 63
- Róheim, Geza (ed.), Psychoanalysis and the Social Sciences, 401
- Roland, Marcel, Chants d'Oiseaux et Musiques d'Insectes, 356
- Romer, A. S., Review of the Labyrinthodontia, 50
- Rosebury, Theodor, Experimental Air-Borne Infection, 176
- Rosen, George, and Caspari-Rosen, Beate, 400 Years of a Doctor's Life, 139
- Rosenberg, H. R., Chemistry and Physiology of the Vitamins, 74
- Rouleau, Ernest, La Florule de l'Île Sainte-Hélène, 55
- Rounsefell, G. A., Development of Fishery Statistics in the North Atlantic, 363
- Rowe, W. H., Our Forests, 355
- Rowlands, J. J., Cache Lake Country, 287
- Royal Society, Newton Tercentenary Celebrations, 408
- Rubinstein, H. S., and Davis, C. L., Stereoscopic Atlas of Neuroanatomy, 165
- Ruedemann, Rudolf, Graptolites of North America, 49
- Runes, D. D. (ed.), The Selected Writings of Benjamin Rush, 45
- Rush, Benjamin, The Selected Writings of, 45
- Rutstrum, Calvin, Way of the Wilderness, 287
- Sadler, W. S., Mental Mischief and Emotional Conflicts, 187
- Sahyun, Melville (ed.), Proteins and Amino Acids in Nutrition, 263
- Salle, A. J., Fundamental Principles of Bacteriology, 266
- Samuels, Jules, Die hormonalen Aspekte des Fortpflanzungsprozesses, 69
- Die Hormonversorgung des Foetus, 67
- Endogeneous Endocrinotherapy, 180
- Sanborn, C. C., Catalogue of Type Specimens of Mammals in Chicago Natural History Museum, 360
- Sanders, E. F., Practical Biology, 341
- Sandow, Alexander, *et al.*, Muscular Contraction, 373
- Saunders, J. B. deC. M., and O'Malley, C. D., Andreas Vesalius Bruxellensis, 343
- Schaeffer, Bobb, Cretaceous and Tertiary Actinopterygian Fishes from Brazil, 50
- Schaub, Isabelle, G., and Foley, M. Kathleen, Diagnostic Bacteriology, 269
- Scheer, B. T., Comparative Physiology, 368
- Schider, Fritz, An Atlas of Anatomy for Artists, 165
- Schneider, E. C., and Karpovich, P. V., Physiology of Muscular Activity, 373
- Schooling behavior in fishes, 27-38
- Schooling, functional aspects, 34
- influence of sexual activity, 33
- physiological basis, 33
- sensory basis, 27
- chemical sensitivity, 28; color vision, 27; influence of central nervous system, 29; influence of form and size, 27; influence of motion, 27; tactile stimuli, 27; vision, 27
- Schwab, George, Tribes of the Liberian Hinterland, 283
- Schwartz, Louis, *et al.*, Occupational Diseases of the Skin, 395
- Schweitzer, Albert, The Psychiatric Study of Jesus, 400
- Science News (4, 5), 195; (7), 408
- Scofield, W. L., Drift and Set Line Fishing Gear in California, 64
- Seiden, Rudolph, Poultry Handbook, 161
- Selling, L. S., Synopsis of Neuropsychiatry, 279
- Selye, Hans, Textbook of Endocrinology, 260
- Semiquinones and reaction kinetics, 207
- Sendrail, Marcel, L'Hyperinsulinie, 272
- Sertillanges, A.-D., La Philosophie de Claude Bernard, 337
- Sexual behavior in the human male, white, U.S.A., 39-42; 397
- Shane, S. M., Out of This World, 262
- Sherif, Muzafer, and Cantril, Hadley, The Psychology of Ego-Involvements, 183
- Sherman, H. C., Calcium and Phosphorus in Foods and Nutrition, 71
- Foods, 377
- Sherman, Mandel, Psychology for Nurses, 184
- Sherrington, Charles, The Integrative Action of the Nervous System, 375
- Shippen, Katherine B., The Great Heritage, 287
- Shirley, H. F., Psychiatry for the Pediatrician, 399
- Shirley, J. C., The Redwoods of Coast and Sierra, 241
- Shoemaker, J. S., Small-Fruit Culture, 248
- Shriner, R. L. (ed), Organic Syntheses (27), 384
- Shriner, R. L., and Fuson, R. C., The Systematic Identification of Organic Compounds, 173
- Shryock, R. H., American Medical Research, 181
- The Development of Modern Medicine, 46
- Siegrist, Marie, and Tatge, Eleanor, Bibliography and Index of Geology Exclusive of North America (11), 147
- Sigerist, H. E., A Fifteenth Century Surgeon, 45
- Silliman, R. P., *et al.*, Intraseasonal and Interseasonal Variations in Average Weight of Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*), 1939-1945, 363
- Simmel, Ernest (ed.), Anti-Semitism, 97
- Simonnet, Henri, L'Oeuvre de Louis Pasteur, 343
- Sinai, Nathan, *et al.*, Health Insurance in the United States, 84
- Sinnott, E. W., Botany, 53
- Slavson, S. R. (ed.), The Practice of Group Therapy, 188
- Slijper, E. J., Comparative Biologic-Anatomical Investigations on the Vertebral Column and Spinal Musculature of Mammals, 66
- Smith, A. H., North American Species of *Mycena*, 239

- Smith, H. M., and Taylor, E. H., Annotated Checklist and Key to the Amphibia of Mexico, 359
- Smith, T. L., Population Analysis, 406
- Smithsonian Inst., Annual Report of the Board of Regents, 288
- A List and Index of the Publications of the United States National Museum (1875-1946), 196
- Snyder, T. E., Our Enemy the Termite, 361
- Soc. for Exp. Biol., Symp. No. 1.: Nucleic Acid, 173
- Somogyi, J. C., Die ernährungsphysiologische Bedeutung der Hefe, 76
- Sorenson, Herbert, and Malm, Marguerite, Psychology for Living, 397
- Soula, L.-C., Précis de Physiologie, 70
- Spiegel-Adolf, Mona, and Henny, G. C., X-Ray Diffraction Studies in Biology and Medicine, 378
- Spies, T. D., Rehabilitation through Better Nutrition, 80
- Spillane, J. D., Nutritional Disorders of the Nervous System, 377
- Spoehr, Alexander, Changing Kinship Systems, 100
- Spratt, E. R. and A. V., Biology for Schools, 341
- Spreading and receding of animals, 1
- Sproull, W. T., X-Rays in Practice, 378
- Stability, principle of, 324
- Stainbrook, M. A., Brachiopoda of the Independence Shale of Iowa, 142
- Stearns, H. O., Elementary Medical Physics, 378
- Stedman's Practical Medical Dictionary, 288
- Stefansson, Vilhjalmur, Not by Bread Alone, 171
- Stiles, K. A., Handbook of Microscopic Characteristics of Tissues and Organs, 165
- Stöhr, Philipp, Jr., Anatomy, Histology and Embryology, 364
- Stout, D. B., San Blas Cuna Acculturation, 191
- Strand, Embrik, Festschrift, II, III, 251
- Strandtmann, R. W., Review of the North American Species of *Philanthus*, North of Mexico, 60
- Strausbaugh, P. D., and Weimer, B. R., General Biology, 45
- Strecker, E. A., Fundamentals of Psychiatry, 399
- Strecker, E. A., *et al.*, Practical Clinical Psychiatry, 279
- Stromsten, F. A., Davison's Mammalian Anatomy, 166
- Strong, O. S., and Elwyn, Adolph, Human Neuroanatomy, 366
- Stutterheim, N. A., Squint and Convergence, 166
- Sullivan, H. S., Conceptions of Modern Psychiatry, 278
- Swingle, D. B., Textbook of Systematic Botany, 55
- Swingle, D. B., and Walter, W. G., General Bacteriology, 387
- Szent-Györgyi, A., Chemistry of Muscular Contraction, 75
- Tactile stimuli and schooling of fishes, 27
- Tannehill, I. R., Drought, 48
- Tanner, F. W. and F. W., Jr., Bacteriology, 266
- Tatnall, R. R., Flora of Delaware and the Eastern Shore, 240
- Taussig, Helen B., Congenital Malformations of the Heart, 365
- Taylor, C. C., Rural Life in Argentina, 286
- Taylor, N. B., Stedman's Practical Medical Dictionary, 288
- Thimann, K. V., and Behnke, Jane, The Use of Auxins in the Rooting of Woody Cuttings, 153
- Thomas, Wendell, On the Resolution of Science and Faith, 135
- Thompson, M. L., *et al.*, Permian Fusulinids of California, 142
- Thompson, W. O., and Spies, T. D. (eds.), 1947 Year Book of Endocrinology, Metabolism and Nutrition, 372
- Thorpe, W. V., Biochemistry for Medical Students, 172
- Tiffin, Joseph, *et al.*, The Psychology of Normal People, 183
- Tiselius, A., *et al.*, Un Symposium sur les Protéines, 381
- Tomkins, S. S., The Thematic Apperception Test, 187
- Tresidder, Mary C., The Trees of Yosemite, 352
- Troisier, Jean, and van der Stegen, J., Méthode Génétique et Tuberculose Pulmonaire, 180
- Troughton, Ellis, Furred Animals of Australia, 62
- Trussell, R. E., *Trichomonas vaginalis* and Trichomoniasis, 267
- Tuchmann-Duplessis, H., Corrélations Hypophyso-Endocrines Chez le Triton, 168
- Turner, C. E., School Health and Health Education, 268
- Turner, W. J. (ed.), A Treasury of English Wild Life, 48
- Twombly, G. H., and Pack, G. T. (eds.), Endocrinology of Neoplastic Diseases, 271
- Tyler, Leona E., The Psychology of Human Differences, 273
- Tyrrell, G. N. M., The Personality of Man, 93
- Underhill, Ruth M., Papago Indian Religion, 100
- Urbach, Erich, and Gottlieb, P. M., Allergy, 272
- Valéry, Paul, The Living Thoughts of Descartes, 42
- Vallois, H. V., Anthropologie de la Population Française, 404
- Van Hiele, T., *et al.*, Onderzoekingen Inzake de Toepassing van Conserveermiddelen bij de Bewaring van Aardappelen, 249
- Verzamelde Rapporten van Proeven Inzake het Bewaren en het Koelen van Uien 1940-1942, 248
- Van Hoosen, Bertha, Petticoat Surgeon, 345
- van Schelven, Theodore, Experiments on the Presence of Carcinogenic Substances in Human Surroundings, 84
- Various Authors, Festschrift for Prof. Embrik Strand, II, III, 251
- Vertebrates, cold-blooded, geographical distribution, 1
- Vision and schooling of fishes, 27

- Visscher, Michel de, *La Régulation Hormonale du Métabolisme et la Vitamine A*, 70
 Vokes, H. E., Contributions to the Paleontology of the Lebanon Mountains, Republic of Lebanon, 143
 Von Bonin, Gerhardt, and Bailey, Percival, *The Neocortex of Macaca mulatta*, 366
 Von Hagen, V. W., *Maya Explorer*, 232

 Wadsworth, A. B., *Standard Methods of the Division of Laboratories and Research*, N. Y. State Dept. Health, 182
 Wain, Harry, *The Unconquered Plague*, 270
 Waksman, S. A., *Microbial Antagonisms and Antibiotic Substances*, 174
 Walden, H. T., II (ed.), *Angler's Choice*, 155
 Wales, H. B., and Lathrop, H. O., *The Conservation of Natural Resources*, 347
 Walford, L. A. (ed.), *Fishery Resources of the United States*, 63
 Walker, Kenneth, *Human Physiology*, 372
 Wall, Col. J. F., *Breeding Thoroughbreds*, 164
 Wallis, W. D., *The Canadian Dakota*, 190
 Walshe, F. M. R., *Diseases of the Nervous System*, 396
 On the Contribution of Clinical Study to the Physiology of the Cerebral Motor Cortex, 259
 War Dept., *Methods for Laboratory Technicians*, 272
 Ward, A. G., *Colloids*, 74
 Ware, E. H., *Wing to Wing*, 236
 Warriner, Doreen, *Land and Poverty in the Middle East*, 284
 Waterman, A. J., *Laboratory Manual of Comparative Vertebrate Embryology*, 169
 Weatherwax, Paul, *Plant Biology*, 53
 Weaver, Warren (ed.), *The Scientists Speak*, 42
 Webb, Addison, *Birds in Their Homes*, 253
 Webber, Irma E., *Anywhere in the World*, 140
 Weindling, Ludwig, *Long Vegetable Fibers*, 247
 Weinmann, J. P., and Sicher, Harry, *Bone and Bones*, 257
 Weismann, 124
 Welsch, Maurice, *Le Dosage Microbiologique des Vitamines*, 263
 Westinghouse, George, *Centennial Forum, Science and Life in the World, I, II, III*, 289
 Wexberg, E. L., *Introduction to Medical Psychology*, 277
 Wheeler, J. A., *Polyelectrons*, 103
 Wheeler, W. F., *Essentials of Biology*, 339
 Whelen, Townsend (ed.), *Hunting Big Game*, 62
 White, Wendell, *Psychology in Living*, 87
 White, W. A., *Twentieth Century Psychiatry*, 399
 Whitell, Evelyn, *The Psychology of Childhood*, 277
 Whitman, William, 3rd, *The Pueblo Indians of San Ildefonso*, 100
 Whitney, L. F., *How To Breed Dogs*, 238
 Wilcox, E. V., *Acres and People*, 193
 Williams, R. T., *Detoxication Mechanisms*, 261
 Willius, F. A., and Dry, T. J., *History of the Heart and the Circulation*, 342
 Wilson, D. W., *Laboratory Manual of Physiological Chemistry*, 384
 Wilson, D. W., *et al.*, *Preparation and Measurement of Isotopic Tracers*, 381
 Wilson, Helen V., *The African Violet*, 352
 Wilson, J. V., *The Pathology of Traumatic Injury*, 393
 Winton, F. R., and Bayliss, L. E., *Human Physiology*, 371
 Witmer, Helen L. (ed.), *Psychiatric Interviews with Children*, 91
 Wodsdalek, J. E., *General Zoology Laboratory Guide*, 154
 Woerdeman, M. W., and Raven, C. P., *Experimental Embryology in the Netherlands, 1940-1945*, 167
 Wolcott, A. B., *Catalogue of North American Beetles of the Family Cleridac*, 154
 Wolf, F. A. and F. T., *The Fungi*, 55
 Wolfenstein, Martha, *The Impact of a Children's Story on Mothers and Children*, 276
 Wolff, P. O., *The Treatment of Drug Addicts*, 273
 Wolff, Werner, *The Personality of the Preschool Child*, 185
 Wood, Laura N., *Louis Pasteur*, 343
 Woodcock, Beatrice, *Scoliosis*, 392
 Worley, C. L., *Basic Principles of General Biology*, 137
 Wormington, H. M., *Prehistoric Indians of the Southwest*, 190
 Worthington, E. B., *Middle East Science*, 195
 Wredden, J. H., *The Microscope*, 409
 Wright, J. K., and Platt, Elizabeth T., *Aids to Geographical Research*, 285
 Wright, W. D., *Researches on Normal and Defective Colour Vision*, 171
 Wyatt, Ruth F., *Improvability of Pitch Discrimination*, 186
 Wyman, Donald, *Arboretums and Botanical Gardens of North America*, 351
 Zelff, C. C., *Laboratory Manual for Introductory Zoology*, 360
 Manual of Medical Parasitology, 389
 Zim, H. S., *Elephants*, 255
 Plants, 58
 Rabbits, 255
 Zimmerman, O. T., and Lavine, Irvin, *DDT: Killer of Killers*, 160
 Zoethout, W. D., *Laboratory Experiments in Physiology*, 370
 Zoethout, W. D., and Tuttle, W. W., *Textbook of Physiology*, 259

Indian Agricultural Research Institute (Pusa)

LIBRARY, NEW DELHI-110012

This book can be issued on or before.....

Return Date	Return Date